FINAL

RI/FS Work Plan

Malone Service Company Superfund Site

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Texas City, Texas

Prepared on Behalf of:

Malone Cooperating Parties

Prepared by:

URS

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EXECUTIVE SUMMARY

The Malone Service Company, Inc. (MSC) site is located in an industrial and petrochemical area of Texas City, Galveston County, Texas, and is constructed on the shores of Swan Lake and Galveston Bay. The MSC Superfund Site was proposed for the National Priorities List (NPL) on August 24, 2000, and was placed on the NPL on June 14, 2001. An Administrative Order on Consent (the "Order") for the remedial investigation/feasibility study (RI/FS) was agreed to by the United States Environmental Protection Agency (USEPA) and the Malone Cooperating Parties (Respondents) on September 29, 2003.

The respondents are required to provide USEPA with a Remedial Investigation/Feasibility Study Work Plan (RI/FS Work Plan). The RI/FS Work Plan documents the evaluations of the existing data and background information from the Preliminary Site Characterization Report (PSCR) and the identification of presumptive remedies in the Preliminary Remedial Alternatives Evaluation Report (PRAER). The objectives of this RI/FS Work Plan are to:

- State the problems and potential problems posed by the site;
- State the objectives of the RI/FS;
- Summarize the site background;
- Document decisions and evaluations completed during the scoping process;
- Describe the work to be performed in the RI/FS, including rationale, methodologies, and schedules; and
- Present the human health and ecological risk assessment work plans, as well as treatability study work plans.

These objectives are accomplished by a discussion and presentation of the:

- Site background and setting,
- Conceptual site model (CSM),
- Preliminary Remedial Alternatives,
- The RI/FS Work Plan rationale,
- RI/FS Tasks,
- Project Schedule, and
- Project Management.

Additional work plans required by the Administrative Order on Consent are contained in Appendices to this RI/FS Work Plan. These additional work plans contain the details for implementing the RI/FS and are included in the following appendices:

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TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

ACRONYM LIST

API	American Petroleum Institute
ARARs	Applicable or relevant and appropriate requirements
ASTs	Above-ground storage tanks
BERA	Baseline Ecological Risk Assessment
bgs	below ground surface
BLHHRA	Baseline Human Health Risk Assessment
BTEX	Benzene, toluene, ethylbenzene, xylenes
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm/sec	centimeter per second
COCs	Chemicals of Concern
COD	Chemical Oxygen Demand
CPT	Cone Penetrometer Tool
CSM	Conceptual Site Model
DQO	Data Quality Objectives
ECA	Environmental Consulting Associates
ERA	Ecological Risk Assessment
FEMA	Federal Emergency Management Agency
FS	Feasibility Study
FSP	Field Sampling Plan
ft/yr	feet per year
GCWDA	Gulf Coast Waste Disposal Authority
MSC	Malone Service Company
msl	mean sea level
NCP	National Contingency Plan
NOR	Notice of Registration
NPL	National Priorities List
NRDA	Natural Resource Damage Assessment

PAHs	Polycyclic aromatic hydrocarbons
PCBs	Polychlorinated Biphenyls
PSCR	Preliminary Site Characterization Report
PPE	Probable Point-of-Entry
PRAER	Preliminary Remedial Alternatives Evaluation Report
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
SARA	Superfund Amendments and Reauthorization Act
SLERA	Screening Level Ecological Risk Assessment
SSI	Screening Site Inspection
START	Superfund Technical Assistance and Response Team
SVOCs	Semivolatile Organic Compounds
TBC	To Be Considered
TCEQ	Texas Commission on Environmental Quality
TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total Dissolved Solids
TMDL	Total Maximum Daily Load
TPH	Total Petroleum Hydrocarbons
URS	URS Corporation
USEPA	United States Environmental Protection Agency
VOCs	Volatile Organic Compounds
yd^3	cubic yards

1.0 INTRODUCTION

The Malone Service Company, Inc. (MSC) site is located in an industrial and petrochemical area of Texas City, Galveston County, Texas, and is constructed on the shores of Swan Lake and Galveston Bay. The MSC Superfund Site was proposed for the National Priorities List (NPL) on August 24, 2000, and was placed on the NPL on June 14, 2001. The United States Environmental Protection Agency (USEPA) and the Malone Cooperating Parties (Respondents) agreed to an Administrative Order on Consent (thethe Order") for the remedial investigation/feasibility study (RI/FS) on September 29, 2003.

1.1 Statement of Work

Included with the Order is a Statement of Work that describes the requirements for the Scoping Phase of the RI/FS. The Scoping Phase includes the following deliverables:

1. Preliminary Site Characterization Report (PSCR), which provides a summary of the known site information (URS 2004a);
2. Preliminary Remedial Alternatives Evaluation Report (PRAER), which selects presumptive remedies for impacted media at the site (URS 2004b);
3. Remedial Investigation/Feasibility Study Work Plan (RI/FS Work Plan);
4. Sampling and Analysis Plan (SAP), which includes the Field Sampling Plan (FSP) and the Quality Assurance Project Plan (QAPP); and
5. Health and Safety Plan (HASP).

This RI/FS Work Plan, and associated work plans, completes the Scoping Phase of the RI/FS. Copies of the PSCR and the PRAER are contained on the compact disk attached to this Work Plan.

1.2 Objectives

This RI/FS Work Plan documents the decisions and evaluations made during the preparation of the PSCR and the PRAER and present the tasks planned for the RI/FS. The objectives of this RI/FS Work Plan are to:

- State the problems and potential problems posed by the site;
- State the objectives of the RI/FS;
- Summarize the site background;
- Document decisions and evaluations completed during the scoping process;
- Describe the work to be performed in the RI/FS, including rationale, methodologies, and schedules; and

- Present the human health and ecological risk assessment work plans, as well as any treatability study work plans.

1.3 Work Plan Structure

This RI/FS Work Plan consists of the following Sections:

- Section 1, Introduction, provides a statement of the purpose and structure of the report;
- Section 2, Site Background and Physical Setting, discusses the MSC Superfund Site location, history, and operating units;
- Section 3, Conceptual Site Model, discusses exposure pathways and receptors;
- Section 4, Preliminary Remedial Alternatives, discusses previous remedial responses, remedial action alternatives, and the presumptive remedies developed in the PRAER;
- Section 5, Work Plan Rationale, discusses the Triad approach, and site-wide and area-specific investigations;
- Section 6, RI/FS Tasks, summarizes the activities to be performed for the RI/FS Guidance tasks
- Section 7, Schedule, presents the project schedule;
- Section 8, Project Management, describes the project organization and decision-making responsibilities for the Triad approach; and
- Section 9, References, lists references used in the preparation of this work plan.

Table 1 summarizes the RI/FS Work Plan components and compares these components to the “Order” requirements.

2.0 SITE BACKGROUND AND PHYSICAL SETTING

The tasks described in the RI/FS Work Plan are based upon an understanding of the site location, history, operations, geology and hydrogeology, ecological setting, and contaminants at the MSC Superfund Site. This section of the report summarizes the site location, history, operations, geology and hydrogeology, ecological setting, and contaminants at the MSC Superfund Site. This information is presented in detail, with references to original data sources, in the PSCR (URS 2004a). Figure 1 depicts the location of the site in Galveston County and Figure 2 depicts the location of operating and non-operating units within the facility.

2.1 Site Location

The MSC Superfund Site is located on Campbell Bayou Road in Texas City, Galveston County, Texas, on the shores of Swan Lake and Galveston Bay, approximately 1.6 miles east-southeast of the intersection of Loop 197 and State Highway 3. The MSC Superfund Site is bordered to the east and northeast by Galveston Bay and Swan Lake, which is an embayment of Galveston Bay. The closed Solutia South 20 waste disposal site borders the site on the southwest. Undeveloped land, owned by Scenic Galveston, in the form of marsh and wetlands, border the southern portions of the MSC Superfund Site. The Gulf Coast Waste Disposal Authority (GCWDA) Campbell Bayou facility is located on the western border of the facility. Northwest of the MSC Superfund Site is a closed Texas City landfill. The MSC Superfund Site encompasses approximately 150 acres. The operating area constituted approximately 75 acres.

2.2 Site History

The MSC Superfund Site received a variety of waste products from surrounding industries, including acids and caustics; contaminated residues and solvents; gasoline and crude oil tank bottoms; contaminated earth and water from chemical spill cleanups; general industrial plant wastes; phenolic tars; and waste oils. The liquids injected into the two deep wells included wastewater submitted to the facility for disposal, stormwater from the Sludge Pit, Oil Pit, and separators, and decontamination water collected in the separators.

The MSC Superfund Site began operating in 1964 as a reclamation plant for waste oils and chemicals. The facility was permitted to dispose of liquid hazardous and non-hazardous waste by means of deep well injection under Injection Well Permit Nos. WDW-73 and WDW-138. Injection Permit No. WDW-73 was issued in 1970 and Injection Permit No. WDW-138 was issued in 1977. Currently, stormwater from some site units is managed by injection into WDW-138 as an applicable or relevant and appropriate requirement (ARAR). The MSC Superfund Site was permitted as a commercial storage, processing and disposal facility authorized to store and process industrial solid waste under Texas Commission on Environmental Quality (TCEQ) Hazardous Waste (HW) Permit No. HW-50003 issued on September 14, 1984. The permit included the following storage/treatment units:

- ninety-six aboveground storage tanks for wastewater or recovered oil
- three underground tanks to service a decanning unit (no evidence of construction)
- one hydrocarbon distillation unit
- one American Petroleum Institute (API) separator
- five hazardous wastewater filters

The permit authorized the receipt of Class 1 and Class 2 industrial solid waste with the exception of wastes containing polychlorinated biphenyls (PCBs), explosives and radioactive or nuclear waste material. The permit authorized the discharge of stormwater runoff. An additional API separator was listed on the company's Notice of Registration (NOR).

Physical operations ceased in January 1996 and the MSC Superfund Site has been inactive since then. On May 6, 1997, the TNRCC revoked permits HW-50003, WDW-73 and WDW-138.

2.3 Site Description

During the facility operations, waste materials accumulated in the earthen impoundment, API separators, and tanks. Two underground injection wells, roll-off bins, a freshwater pond, chemicals within the facility laboratory, and metal drums inside small buildings were left on the MSC Superfund Site after the plant was closed.

2.3.1 Earthen Impoundment

During early operations, incoming wastes were placed into two earthen, unlined pits, which comprise the earthen impoundment. The earthen impoundment was formed by excavating into the sand of a paleochannel that crosses from northwest to southeast beneath the MSC Superfund Site. The earthen impoundment operated from 1964 to 1979. The impoundment consists of two pits; the large pit is termed the "Sludge Pit" and the small pit is termed the "Oil Pit". The Sludge Pit was used as a waste receiving/treatment unit for the separation of oil, water, and solids from a variety of industrial waste streams. The oil fraction that rose to the top of the larger pit was skimmed off the surface and deposited into the Oil Pit. This oil was then pumped to one of several tanks for treatment, after which it was resold as waste oil for energy recovery. Solids remained in the Sludge Pit and the aqueous phase was disposed of by deep well injection.

Volume estimates for the Sludge Pit range from 163,000 cubic yards (yd^3) to 307,400 yd^3. Most of the volume variation is due to the differences in estimating the depth of the earthen impoundment. Earthen dikes surround the impoundment with a height of about 15 feet above natural grade and an average crest elevation of about 23 feet above mean sea level (msl). Depth profiles of the waste material within the Sludge Pit were measured in 1989 along transects within the impoundment with the deepest points approximately 40 feet. The average depth of the impoundment floor was calculated as approximately 37 feet below the crests of the levees.

The Oil Pit operated from 1964 to 1979. The dimensions are 200 feet by 100 feet by 33 feet deep with volume estimates ranging from 20,740 yd^3 to 29,630 yd^3.

2.3.2 Other Pits

The Former Backwash Pit operated from 1970 to 1982. The Backwash Pit was located approximately 100 feet south of the Unit 700 area and directly east of the Oil Pit. Based on the description of the location in USEPA documents, an approximate location of the Backwash Pit is shown in Figure 2. The pit volume was approximately 465 cy^3 (50 feet by 50 feet by 5 feet). The pit was used to dispose of the Unit 700 (WDW-73) filter backwash water. In 1982 (or later), Malone Services Company excavated the pit until the natural clay was visible. No confirmatory sampling was performed. Excavated soils were reportedly placed in the Sludge Pit and the Backwash Pit was backfilled and returned to the original surface grade.

A 1969 aerial photograph (Figure 3) of the MSC Superfund Site shows five oil/water pits (slop oil pits) near the Sludge Pit. The location of one pit appears to be under the paved area behind the shop and north of the earthen impoundment and two pits were located in the current Tank 300 area. The other two pits were located in a cleared area north of the Tank 300 area and east of the 400 series tanks. The pits do not appear on a 1978 aerial photograph. Closure records for these pits have not been located.

2.3.3 Freshwater Pond

The drainage ditch system throughout the facility discharged into the Freshwater Pond located on the west side of the MSC Superfund Site (Figure 2). The drainage system collected stormwater and any spills that escaped the containment areas in the plant process areas. The Freshwater Pond is an excavated pit with a volume of approximately 20,000,000 gallons.

2.3.4 Unit 100 API separator

The Unit 100 API separator is an in-ground, concrete unit consisting of four separate basins (A, B, C, and D) and a system of baffles and/or weirs. The separator was installed in 1978. A truck unloading area was located adjacent to the separator. The separator is located near the center of the MSC Superfund Site, adjacent to and southeast of the Sludge Pit. The separator is located above the paleochannel that crosses beneath the MSC Superfund Site.

The separator was used for the equalization of various waste streams and separation into aqueous, organic, and solid phases. The oil fraction was removed from the surface of the separator and pumped or trucked to the oil blending tanks for reclamation. The aqueous phase was ultimately pumped to one of the injection wells for disposal. Solids were removed with a backhoe to a solids handling area on the far side of Basin A or to the Solids Mixing Bin. Reportedly, acid neutralization, caustic neutralization and flocculation also occurred in the separator.

The volume of the Unit 100 API separator was estimated by USEPA as 23,150 yd^3. The dimensions of separator basins A and B are 135 feet by 20 feet by 6 feet deep and 100 feet by 30 feet by 6 feet deep for Basins C and D. The separator is surrounded by a 12-inch thick concrete wall and underlain by a 12-inch thick concrete floor. Pumps and filters associated with Unit 100 were located in the Unit 100 Pump House and on a concrete pad outside the Unit 100 pump. Each filter had an approximate capacity of 100 barrels. The gravity sand media was changed approximately every 18 months and fine sands and spent media were deposited in the Unit 100 API separator Basin.

2.3.5 Unit 1200 API separator

The facility operated one additional separator, designated as the Unit 1200 API separator. The separator is located on the east side of the plant processing area, just south of the Unit 1100 area. This separator served the same purpose as the Unit 100 API separator. Most of the waste that entered the plant was treated in the Unit 100 API separator; the Unit 1200 API separator served as a backup. This separator was installed and put in service in 1987.

The separator consists of:

- four large (60 feet by 60 feet by 6 feet deep) settling basins (approximately 3,200 yd^3),
- two small (20 feet by 60 feet by 6 feet deep) settling basins (approximately 530 yd^3), and
- one large (145 feet by 60 feet by 6 feet deep) solids treatment area (approximately 1,900 yd^3).

Each basin is lined with 12-inch thick concrete floors and outer walls, and 5-foot high inner walls. A 20-inch high, 2-foot thick concrete wall surrounds the separator. This wall is surrounded on all four sides by a concrete pad.

Wastes flowed between the four large and the two small basins by overflowing the internal concrete walls. Water and oils in the small basins were transported to the Unit 100 API separator using a vacuum truck. Sludge was removed from the basins using a clamshell bucket and placed in the solids treatment area. A sludge profile generated during the 1999 removal assessment showed the sludge depths to be approximately one to 6.8 feet.

During facility operations, sludge was mixed with fly ash and gypsum in the solids treatment area using a small front loader. The solidified solids from the Unit 100 API separator were also placed in the solids treatment area. After solidification, solids were loaded into dump trucks and reportedly hauled off-site for disposal.

2.3.6 Above-Ground Storage Tanks

Several aboveground storage tanks (ASTs) were constructed at the facility. These tanks, which are located in Unit 300, Unit 400, and Unit 800, accepted oils pumped or transported by vacuum truck from the Unit 100 or Unit 1200 separators. The 700 and 1100 series tanks were used to support the injection well disposal activities.

The Unit 300 Tank Farm contained 46 tanks. Tanks 301 – 336 (36 tanks) were used to store/blend reclaimed oil. Two tanks (Tanks 337 and 339) were used as final product storage for reclaimed oil. Tanks 338 and 340 were reportedly unused because of unstable soil conditions at the proposed tank locations. Six tanks (Tanks 341 – 346) stored materials used in the plant processes such as brine water and barite. All tanks are located within the same clay containment area.

The Unit 400 Tank Farm contained six tanks (Tanks 401 – 406) that were used to blend reclaimed oils. All six tanks are located within the same clay containment area. A transfer sump for the Unit 400 Tank Farm collected spilled material during transfers in and out of the tanks. The sump was constructed using 6-inch thick concrete. The sump capacity was approximately 100 gallons.

The Unit 800 tank farm consisted of six ASTs (Tanks 801 – 806). Each tank was contained within its own earthen containment. The tanks were used to store and blend reclaimed fuel oil. Three transfer sumps were located approximately 200 feet apart on the southern border of the Unit 800 Tank Farm. The capacity of each sump was approximately 100 gallons.

2.3.7 Sumps

Five "transfer" sumps were located around the inlet and outlet pump lines of several tanks. These sumps were reportedly used to collect any spills from pumping oil or wastewater in or out of these tanks. Three sumps were located in the Unit 800 Tank Farm, one at Tank 700, and one at the southern end of the Unit 400 Tank Farm. An unused sump (in 1988) was located at the north end of the Unit 400 Tank Farm. Two 2200-gallon concrete-lined sumps were located at the wastewater disposal areas (Units 700 and 1100). Materials collected in the sumps were reportedly pumped into a vacuum truck and taken back to the Unit 100 API separator.

2.3.8 Distillation Unit

The distillation unit (Unit 900) was constructed in 1978 to treat incoming oil wastes by distillation. The unit was reportedly only used once, in 1985, when crude oil was distilled into light (naphtha and kerosene) and heavy fractions. The unit consisted of two distillation columns, one boiler, and thirteen tanks (901 – 913). The unit is located on a concrete pad and is surrounded by a 3-foot high concrete wall.

2.3.9 Injection Well WDW-138

This injection well is located in the northeast corner of the plant process area and was part of the Unit 1100 waste disposal area. This well was the facility's primary injection well, disposing of most of the wastewater treated at the plant. Wastewater was injected for disposal into the Miocene sands at a subsurface interval between 3800 and 5300 feet.

A concrete-lined 2200-gallon capacity sump was located directly east of the well head. Two wastewater tanks, Tanks 1102 and 1103, stored wastewater prior to injection. The tanks were located on the Unit 1100 concrete pad, which was surrounded by a 3-foot high concrete wall. The concrete pad drained to the Unit 1100 sump. Two filter systems were installed to filter wastewater prior to injection.

WDW-138 has passed the most recent mechanical integrity tests (Sandia 2004). The well is currently operated to manage site stormwater under a TCEQ and USEPA approved Stormwater Management Plan and Operations and Management Plans (URS 2005a, URS 2005b).

2.3.10 Injection Well WDW-73

Injection well WDW-73 is part of the Unit 700 area. Filtered wastewater was injected for disposal at a subsurface interval of 4650 to 5300 feet in the Miocene Sands.

Three filter systems, two filter pumps and three injection pumps were located at Unit 700. Two filter pumps transferred wastewater in the Unit 700 area to the three filters. Two open-topped, gravity sand filters were located on a concrete pad surrounded by a 2-foot high concrete wall. The third filter was a closed top, gravity sand system designed for filtering odorous wastewater. Spent filter media was disposed of in the Unit 100 API separator.

In addition, the unit contained a transfer sump at Tank 700. The sump collected spilled material during transfers in and out of Tank 700. The sump was constructed of 6-inch thick concrete with one side 3-feet high and the opposite side 8-inches high. The capacity of the sump was approximately 100 gallons. Material collected in the sump was vacuumed and transferred to the Unit 100 API separator.

Five storage tanks were associated with the unit. Tanks 704, 705, 709 and 710 were located within a curbed concrete pad that drains into the Unit 700 sump. Tank 700 was located approximately 100 feet south of the Unit 700 pad. Tank 700 was placed on a raised concrete pad with natural clay containment.

2.3.11 Buildings, Utilities and Wells

In addition to tanks and structures associated with the facility operations, several buildings remain at the MSC Superfund Site, including the office, shop, and laboratory building. Other buildings include the weight room, two buildings located between Unit 700 and Unit 900, and a small office located near the Unit 1100 injection well.

Small equipment was cleaned and repaired in the maintenance shop. Two drums of recyclable cleaning solvents were provided by Safety Kleen to clean the small equipment.

Five septic tanks were located in the facility in the following locations:

- Unit 1100 – adjacent to small office and pump house
- Unit 900 – one behind the building labeled restroom and one behind the building labeled lunchroom (former laboratory septic tank)
- Shop – south side (back) of shop
- Office – adjacent to building on west side

In addition, three laboratory waste holding tanks were located on the west side of the laboratory.

Two stormwater discharge sumps are located on the northern side of the facility. Each sump contains a plate that can be lowered to block the discharge. The sumps have large hand screw operated flapper-gates that can be closed manually to prevent water flow in either direction. The sumps are connected to the stormwater outlet that discharges through the flood protection levee into the marshy area between the MSC Superfund Site and Swan Lake. Currently, the plates are closed to prevent stormwater runoff from the site to the marsh area and Swan Lake.

Monitoring wells, MW-01 through MW-20, and MW-24, were field verified by URS during site visits conducted in March 2004. Available information indicates that monitoring wells, MW-21, MW-22 and MW-23, were abandoned by MSC. Attempts to locate these wells based on site drawings have not been successful.

A non-potable water well is located in Unit 700. According to available information, this well was not used as a drinking water source during facility operations and is currently not used as a drinking water source.

2.3.12 Decanning Area

In August 1981, Malone Services Company notified the TCEQ of the intent to process approximately one million gallons of Silvex by shredding the containers, allowing the Silvex to flow into a surge tank prior to transfer to a bulk storage tank. The shredded containers would then be triple rinsed through a series of rinsing baths and then loaded into a dumpster box prior to disposal in a Class 1 landfill. The decanning process area was designated in the northeast portion of the facility, east of the Tank 800 area and north of Unit 1100. The 1996 NOR lists three tanks (105 through 107) as decanning unit tanks. The tanks were inactive on the 1996 NOR. It is unknown at this time whether the decanning process was ever constructed or operational.

2.3.13 Cemetery

The Campbell Bayou Cemetery is located on the property, between Unit 900 and the Oil Pit (Figure 2). The cemetery, which served the settlers of Campbell Bayou, is mentioned on a historical marker located near Interstate 45. Reportedly, James and Mary Campbell settled on a one-third league of land (1,476 acres) on Campbell's Bayou at Swan Lake in 1838. Prior to that, the Campbell's lived in Jean Lafitte's corsair community of Campeche. James Campbell served Lafitte aboard four different privateers. The Campbell's and other residents of Campbell's Bayou are reportedly buried in the Campbell Bayou cemetery.

2.3.14 Laydown Area

The Laydown Area is located in the northern part of the MSC Superfund Site, between the Freshwater Pond Area and the hurricane levee adjacent to Swan Lake (Figure 2). The area was used for storage of miscellaneous equipment, debris and concrete rubble that remains on-site. There is no evidence of waste disposal or waste storage activities in the Laydown Area, but the miscellaneous equipment, debris and concrete rubble may have contained waste materials. Visual observations indicate the discharge/runoff from on-site drainage ditches was (and is currently) channeled to the Freshwater Pond and the Laydown area.

2.4 Chemical Constituents

Impacts to groundwater were discovered at the MSC Superfund Site in 1979. Subsequently, samples collected in January 1986 from the Unit 100 API separator and the Earthen Impoundment exhibited hazardous waste characteristics with numerous organic and inorganic substances being detected. Historical data from sample events conducted from 1986 to 1997 were compiled and submitted in the PSCR (URS 2004a). Table 2 summarizes the maximum historical analyte concentrations in groundwater, sediment, soils and source materials. This data is provided to show relationships between analytes detected in the sources and analytes detected in the groundwater and soils media.

2.4.1 Sources of Contamination

The primary sources (sources with the largest volume of impacted media) of contamination identified at the MSC Superfund Site are the earthen impoundment (the Sludge Pit and the Oil Pit) and the Unit 100 API separator. Other potential sources of contamination included the Unit 1200 API separator and the tanks. Miscellaneous potential sources (sources which may have released contaminants to soils and groundwater) include the Closed Backwash Pit, the Laydown area in the northwest corner of the MSC Superfund Site, the distillation unit, ancillary piping, the filters and pumps associated with the injection wells, the laboratory sumps, and the proposed decanning area, may have contributed to impacted soil and groundwater but the current data are inadequate to make a determination.

As shown in Table 2, metals, such as antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc, were detected in the majority of samples. Barium was not listed as detected in the tank and container samples, since it was not included on the removal action analyte list. However, barium was reported as present in the twenty-one samples analyzed for toxicity characteristic leaching procedure (TCLP) metals.

The semivolatile organic compounds (SVOCs) detected in the source areas included PAH, phenolic compounds, and phthalate esters. The most frequently detected SVOCs were naphthalene, 2-methylnaphthalene, bis(2-ethylhexyl)phthalate, phenol, phenanthrene, 1,2,4-trichlorobenzene, and acenaphthene. Volatile organic compounds (VOCs) detected in the impoundments, separators and tanks included the aromatic and chlorinated hydrocarbons. The most frequently detected VOCs were total xylenes, ethylbenzene, tetrachloroethene, toluene, 1,1,1-trichloroethane, styrene, trichloroethene, and benzene.

2.4.2 Groundwater

Total dissolved solids (TDS) concentrations in samples collected from the MSC Superfund Site monitoring wells have ranged from 1624 mg/L in MW-24 to 20,026 mg/L in MW-05. These concentrations indicate that the groundwater in the paleochannel would not be considered potable water. The lower TDS concentration in MW-24 may be indicative of the influence of the Freshwater Pond on groundwater in the southwest portion of the MSC Superfund Site.

Table 2 summarizes the groundwater constituents and maximum concentrations detected in groundwater at the site. Historical data indicate that groundwater in the vicinity of four wells adjacent to the earthen impoundment and Unit 100 API separator have been impacted by releases from the sources. These wells are located in the paleochannel adjacent to the Sludge Pit. Wells located at the boundary of the facility and wells located around the Unit 1200 API separator have little or no detections of organic compounds. The wells located around the Unit 1200 API separator are reportedly completed outside the paleochannel. Malone Services Company conducted the most comprehensive groundwater sampling event in January 1994. The analytes detected in wells adjacent to the earthen impoundment were still not detected at the facility boundary as late as January 1997, suggesting that impacted groundwater is confined to the paleochannel and has not migrated off-site.

2.4.3 Soils and Sediments

A soil sample was collected during the 1997 Site Screening Inspection (SSI) at the base of the berm for the earthen impoundment in an area that appeared to have a seep. Two soil samples within the bermed areas of Tanks 339 and 806 were collected during the E&E removal action.

Table 2 summarizes the metal, SVOC and VOC analytes detected in the soil and sediment samples from the MSC Superfund Site. As shown on Table 2, the analytical data indicate potential releases to the soils of chlorinated VOCs, polycyclic aromatic hydrocarbons (PAHs), and metals.

Methylene chloride and bis(2-ethylhexyl)phthalate were detected in the background sample. The methylene chloride concentration in the field sample was comparable to the background concentration. Benzene, ethylbenzene, toluene, and total xylenes were detected in the field sample adjacent to the earthen impoundment and in the soil samples collected within the bermed areas of Tank 339 and Tank 806. In addition to the volatile aromatic compounds, 1,1-dichloroethene, 1,1,1-trichloroethene, and trichloroethene, were detected in the tank area soils.

Pyrene was the only SVOC detected in the soil from the earthen impoundment area. Concentrations of pesticides detected in the January 1997 SSI were less than the Region 6 Human Health Medium Specific Screening Levels. Phthalate esters and PAHs in the Tank 339 and Tank 806 soil samples exceeded the Region 6 Screening Levels.

The beryllium, chromium, cobalt, copper, lead, nickel, vanadium, zinc and cyanide concentrations in the impoundment samples were comparable to concentrations in the background soil sample. Arsenic, chromium, and lead concentrations in the soils from the January 1997 TCEQ sample event and the August 1999 E&E sample event exceeded the Region 6 Screening Levels.

Acetone, carbon disulfide, methylene chloride, toluene, bis(2-ethylhexyl)phthalate and PAHs were detected in the background sediment samples collected by the TCEQ during the SSI. This background sample data was used by the TCEQ to evaluate potential releases from the MSC Superfund Site.

Two sediment samples were collected from drainage ditches located within the facility during the SSI (Figure 4). These samples contained benzene, ethylbenzene, toluene and total xylenes (BTEX), PAHs, phthalate esters, as well as the chlorinated hydrocarbons, hexachlorobutadiene, hexachlorobenzene, 2-chloronaphthalene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, and 1,2,4-trichlorobenzene. Chlorinated pesticides were reported present in one sample but pesticides and PCBs were not detected in the other on-site sediment sample. The concentrations of barium, beryllium, cobalt, lead, manganese, nickel, and vanadium reported for the two on-site samples were comparable to the range of concentrations detected in background samples. The concentration ranges for antimony, arsenic, cadmium, chromium, copper, and zinc were greater in the on-site drainage ditch samples than in the background samples. The sediments and soils in the MSC Superfund Site ditches were cleaned, scraped and/or excavated as part of the EPA's emergency responses, and the materials disposed of off-site (Zehner 2004).

Eight sediment samples were collected from outside the flood protection levee in the marshy area (Figure 4). Samples were collected from the drainage channel parallel to the north levee, and along the shorelines of Swan Lake, Campbell Bayou, and Galveston Bay. Acetone, carbon disulfide, methylene chloride, 2-butanone, and bis(2-ethylhexyl)phthalate were detected in these samples at concentrations comparable to the background samples. Other phthalate esters, di-n-butyl phthalate, di-n-octyl phthalate and diethyl phthalate were also detected in some of the samples. Total PAH concentrations in the eight sediment samples ranged from 0.067 mg/Kg to 0.945 mg/Kg and PCBs (Aroclor 1248, 1254 and 1260) were detected in four sediment samples. Trace detections of pesticides were reported for four samples. The concentrations of antimony, arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc in the off-site samples were greater than the range of concentrations in the background samples and in the

TexTin reference samples. The maximum detections were generally in a sample located in the small drainage channel in the marshy area adjacent to the MSC Superfund Site and north of the stormwater discharge.

The following are indicated from the sediment data:

- on-site impacts from selected metals, aromatic VOCs, chlorinated hydrocarbons, chlorinated pesticides, and PAHs to on-site drainage ditches, which were possibly later addressed by the EPA emergency response team's removal of ditch sediments/soils; and
- potential impacts to the off-site marshy area adjacent to the MSC Superfund Site from selected metals, PAHs, and pesticides.

A comparison of the metals data from the on-site drainage ditches to the off-site sediments indicates that the antimony, arsenic, cadmium, chromium, copper, and zinc may be attributable to the MSC Superfund Site, but that the lead, mercury, nickel and silver may not be attributable to the MSC Superfund Site.

Two Swan Lake locations near the MSC Superfund Site were characterized during the ecological risk assessment (ERA) for the TexTin Superfund Site (USEPA 1998). The selection of appropriate reference locations for the TexTin ERA was complicated by other sources of contaminants, including petrochemical facilities, a wastewater treatment plant, chemical storage areas, and shipping lanes and chemical loading and unloading terminals. Three reference locations, each representative of a habitat type, salt marsh, ditch channel, and Swan Lake, were chosen for the ERA. A salt marsh situated on the northern shore of Galveston Island was considered as a reference location for the marsh habitat and a location in Galveston Bay near the TexTin site (TT-15) was chosen as a reference for Swan Lake (Figure 4). However, due to substrate, hydrology and water depth differences between the Galveston Bay reference location and Swan Lake, TT-14, adjacent to the off-site marsh area between the MSC Superfund Site and Swan Lake was chosen as internal reference. This choice was justified on the basis of prevailing water movement from south to north through Swan Lake and the fact that Location 14 had the lowest concentrations.

With the exception of arsenic, copper, lead, tin and zinc, the concentrations of metals were higher in Galveston Bay than in the southern portion of Swan Lake, that is the area tested by TexTin nearest the MSC Superfund Site. Analytical results were compared to literature values for adverse effects for the benthic macroinvertebrate community. Based on a comparison to literature values, the TexTin risk assessment concluded that the Swan Lake benthic community did not appear to be at risk from the copper, mercury, nickel, and zinc concentrations detected at the TexTin reference location, near the MSC Superfund Site (USEPA 1998).

2.5 Adjacent Land Use

The land surrounding the facility, from Interstate 45 north to Texas City, is zoned for heavy industry. The land directly north and west of the MSC Superfund Site (approximately 200 acres) is owned by GCWDA. The GCWDA Campbell Bayou Facility provides landfill disposal of nonhazardous wastes to area industrial facilities. The former Texas City Municipal Landfill was located northwest of the MSC Superfund Site. The remaining 1,500-acre property surrounding GCWDA and the MSC Superfund Site was owned by the University of Texas and, as of February 2, 2004, was sold to Scenic Galveston, Inc. Scenic Galveston is a non-profit land trust and conservation organization with the goal of creating a high visibility marsh preserve along the highway approach to Galveston Island. According to Scenic Galveston literature, the property is permanently deed restricted for habitat conservation and compatible public use. Scenic Galveston controls access to the MSC Superfund Site through an easement granted to the MCP.

The closed Solutia South 20 waste disposal site, pre-RCRA landfill, is directly adjacent to the MSC Superfund Site to the southeast.

The MSC Superfund Site is located approximately two miles south of the Texas City Industrial Complex, which includes several oil refineries, oil tank farms, chemical plants, loading docks, shipyards, municipal and hazardous waste landfills, and the TexTin Superfund site. In addition to industrial activities, the area has numerous oil and gas wells.

No residents live within one mile of the site. The nearest residential center to the MSC Superfund Site is Bayou Vista, approximately 1.5 miles to the southwest, across Interstate 45, along State Highway 6 (Figure 1). A residential section of Texas City is approximately four miles north of the MSC Superfund Site.

2.6 Meteorology

The MSC Superfund Site is located in the warm, moist Texas Coastal Zone. Temperatures range from a January minimum of 43°F to a summer average maximum of 94°F. Between 1931 and 1960, the average annual air temperature in the Houston-Galveston area was about 70°F. The prevailing winds, from the southeast, blow from the MSC Superfund Site towards the Texas City Industrial Complex.

Annual rainfall near the MSC Superfund Site ranged from 35 to 74 inches from 1964 to 2002, with an average annual rainfall of 50.6 inches. Annual lake surface evaporation ranged from 38 to 58 inches in the same period, with an average annual evaporation rate of 48.0 inches. Since 1964, several major tropical storms and hurricanes have adversely affected the Galveston-Houston area. The 24-hour rainfall record (43-inches) for the continental United States was recorded in Alvin, Texas during Tropical Storm Claudette in 1979. Alvin, Texas is located approximately 20 miles west of the MSC Superfund Site. Since 1957, only one tropical storm or hurricane made landfall on the Texas Coast with a storm surge exceeding the height of the flood protection levee surrounding the MSC Superfund Site. A maximum storm surge of 22 feet was recorded during Hurricane Carla in 1961.

Rainfall runoff collected within the waste management areas was disposed through deep well injection. Stormwater collected from the undeveloped areas was reportedly routed to a control retention area then pumped outside the flood protection levee through a discharge outfall along the north levee to Swan Lake/Galveston Bay.

The Federal Emergency Management Agency (FEMA) Flood Rate Insurance Map for Texas City, Texas shows the area south of Texas City and east of Highway Loop 197 located within the 100-year flood plain. A flood protection levee completely surrounds the MSC Superfund Site (and the waste management units). The levee was built with an average crest elevation of 5.5 m (18 ft) above msl, and with an average elevation of approximately 3 m (9 ft) above msl around the undeveloped area in the northeast corner of the MSC Superfund Site.

2.7 Geology and Hydrogeology

The MSC Superfund Site is located within soils of the Ijam-Urban land complex, which consists of nearly level, poorly drained, moderately saline, clayey soil with a clayey subsoil and Urban Land. Typically, these soils have a surface layer that is calcareous, dark grayish brown clay about 12 inches thick. The upper part of the underlying material, to a depth of 40 inches, is dark gray clay. The lower part, to a depth of 60 inches, is gray clay. The soil is moderately saline and moderately alkaline throughout. The Urban Land consists of soils that have been altered or obscured by buildings, sidewalks, parking lots and wharves. The soils in this complex are very slowly permeable. Surface runoff is very slow and the soils are rarely flooded by storm tides.

Soils adjacent to the MSC Superfund Site on the east and northeast and in areas along the shore of Swan Lake and Galveston Bay are included in the Follet Loam. This soil is a nearly level, poorly drained, saline, loamy soil that has loamy subsoil located in broad tidal marshes. Typically the surface layer is a mildly alkaline, gray loam, about eight inches thick. The upper part of the underlying material to a depth of 40 inches is a moderately alkaline, light gray loam. The lower part to a depth of 60 inches is moderately alkaline, light gray clay loam. The surface water runoff is very slow. The high water table allows for very little water movement through the soil. The soil remains saturated throughout the year and is covered with two to twelve inches of water during high tides.

The MSC Superfund Site is located on the Gulf Coastal Plain in Southeast Texas. The stratigraphic units that underlie the Texas coastal plain and form the principal hydrogeologic units from oldest to youngest include: the Fleming Formation of Miocene age; the Goliad Formation of Pliocene age; the Willis Formation, Bentley Formation, the Montgomery Formation, and the Beaumont Formation of Pleistocene age; and the alluvium of Quaternary age. Collectively, these sediments attain a thickness in excess of several thousand feet along the coastline and consist primarily of interbedded sands and clays with subordinate beds of silt and gravel. Regionally, these stratigraphic units dip toward the Gulf of Mexico and tend to thicken progressively deeper basinward. The two principal hydrogeologic units that supply fresh water to Houston-Galveston area including Texas City are the Evangeline aquifer and the Chicot aquifer.

Surface outcrops in southeast Texas generally parallel the coastline, with older formations found progressively inland. The MSC Superfund Site is located on outcrops of the Beaumont Formation that covers most of Galveston County. The Beaumont Formation consists of fluvial and deltaic sediments including low permeability clays interbedded with more permeable discontinuous silt and sand lenses. These sediments include stream channel and point bar, natural levee, backswamp, and, to a lesser extent, coastal marshes and mud flat deposits.

The shallow subsurface strata beneath the MSC Superfund Site primarily consists of an upper fine sandy to silty clay underlain by a low permeability, stiff red or gray clay to a depth of at least 40 to 45 feet below ground surface (bgs). A conceptual lithologic model for the site, based on GCWDA and MSC cross-sections and boring logs, is depicted in Figure 5. The major limitation in the subsurface stratigraphy beneath the MSC Superfund Site is the absence of geologic data below 40 to 50 feet bgs. One groundwater supply well was reportedly drilled in 1968 to a depth of 750-ft bgs and screened across a sand interval between 700 and 750 feet bgs. A second well, installed in 1975 to a depth of 200-ft bgs and screened across a sand interval between 185 to 198 feet, had poor water quality. A thick clay interval more than 100 feet thick reportedly separates the buried paleochannel sand aquifer from the lower sand aquifer. Stratigraphic information from the adjacent GCWDA facility shows a 4-foot thick sand and silt zone at a depth of 88 feet bgs. It is unknown whether this permeable unit is laterally extensive beneath the MSC Superfund Site.

The hydrogeology in the immediate vicinity of the MSC Superfund Site is dominated by a prominent buried paleochannel that meanders southeast from Highway Loop 197 toward Galveston Bay and forms a wide arch beneath the MSC Superfund Site from the southwest to the southeast. A smaller distributary channel bifurcates from the main channel near the center of the MSC Superfund Site and trends to the north-northeast to Swan Lake. The surface expression of the buried paleochannel is evident on early aerial photographs by variations in soil type and vegetation. Figure 6 depicts the paleochannel on the site features map.

The buried paleochannel consists of a fairly uniform tan, very fine-grained, silty sand with an upper boundary found at about 10 feet bgs and a base at about 30 feet bgs on top of the red clay. The width of the buried paleochannel varies from about 200 to 1000 feet. Horizontal field permeability values for the paleochannel aquifer range from 10^{-5} to 10^{-3} cm/sec, and laboratory permeability values on samples of the paleochannel silty sands ranged from 10^{-6} to 10^{-4} cm/sec. Laboratory permeability values for samples of the surrounding fine-grained sediments ranged from 10^{-9} to 10^{-6} cm/sec. Groundwater flow in the paleochannel aquifer is variable, primarily controlled by the recharge pattern in the Freshwater Pond to which it is hydraulically connected.

Additional hydraulic boundary conditions potentially influencing groundwater movement include liquid and sludge stored in the earthen impoundment, tidal influences from Swan Lake/Galveston Bay, and the closed Solutia South 20 waste disposal site downgradient of the MSC Superfund Site. Groundwater flow velocities calculated using available hydrogeologic data vary from 0.84 ft/yr to 44 ft/yr.

2.8 Ecological Setting

The MSC Superfund Site is located adjacent to the south shore of Swan Lake and the western shore of Galveston Bay (Figure 1). Swan Lake and the western shore of Lower Galveston Bay are separated by a series of intermittent north-south trending sediment banks or islands (now supplemented with intermittent rock jetties as part of the TexTin Superfund Site Operable Unit 4 Remedy), that connect through Campbell Bayou and other shallow channels as part of the larger Galveston Bay System. Lower Galveston Bay is designated as Texas Water Quality Segment 2439 of the Texas Bays and Estuaries. The Lower Galveston Bay Segment is connected with Texas Water Quality Segment 2421 (Galveston Bay), Segment 2422 (Trinity Bay), Segment 2423 (East Bay) Segment 2424 (West Bay), and the Gulf of Mexico (TNRCC 2000). The Galveston Bay system, the seventh largest estuary in the United States, is designated as a National Estuary as part of the National Estuary Program.

2.8.1 Galveston Bay

Galveston Bay provides habitat for brown shrimp (*Penaeus aztecus*), a species economically important to the region.

Rainfall runoff discharge and groundwater to surface water discharge from the MSC Superfund Site enter Texas Water Quality Segment 2439 – Lower Galveston Bay. The Lower Galveston Bay segment encompasses approximately 140 square miles. Water quality is considered limited based on restricted oyster harvesting. Designated water uses for the Lower Galveston Bay segment include aquatic life use, contact recreation use, general use, fish consumption use, and oyster waters use. A Total Maximum Daily Load (TMDL) assessment for bacteria is underway for Segment 2439 with a projected completion date of 2008.

There are no known or suspected surface water drinking intakes located in the Lower Galveston Bay segment. Several industrial surface water intakes are located in the Texas City area. One permitted surface water intake is located at the Texas A&M University Galveston Experimental Laboratory on Pelican Island. Surface water withdrawn through this intake is used to water saltgrass. There are six domestic and sixteen industrial outfalls permitted for wastewater discharge into Segment 2439.

2.8.2 Swan Lake

The depth of Swan Lake ranges to approximately three feet and the substrate consists of varying depths of semiconsolidated, fine-grained organic mud overlying a firm clay substrate. The prevailing water movement through Swan Lake is from the south to the north. Data gathered during investigations of the TexTin Superfund site, showed the highest concentrations of metals tended to be detected in the northern portion of Swan Lake, thus supporting either that the general trend for transport of materials in the lake is to the north and/or the sources of these metals are in the north of Swan Lake. Tidal action, currents, winds, and storms influence surface water in the area. Residence time of the surface water in the lake is expected to be short, and there is relatively free exchange of water between Swan Lake and Galveston Bay (USEPA 1998). The relatively free exchange of water between Swan Lake and Galveston Bay and the inability to trace the contaminants to the TexTin site was accepted as a justification for not evaluating surface water in the TexTin ERA.

2.8.3 Site Habitat

Swamp and marshlands are located directly adjacent to the MSC Superfund Site on the east and northeast, extending to the shore of Swan Lake and Galveston Bay and to the south. Approximately 1.61 miles (8500 feet) of wetlands frontage is adjacent to the MSC Superfund Site. The Swan Lake/Galveston Bay wetlands encompassed by these locations are classified as estuarine, intertidal, unconsolidated shoreline, irregularly exposed (E2USM) and estuarine, intertidal, emergent, persistent, regularly flooded (E2EMIN). Wetlands are also identified along the shell islands between Swan Lake and Galveston Bay. The National Wetlands Inventory Map for the Virginia Point quadrangle classifies the swamp/marsh land adjacent to the MSC Superfund Site as being intertidal, estuarine, unconsolidated shore, irregularly exposed lands and intertidal estuarine, emergent, persistent, regularly flooded lands. These areas follow the shoreline of Swan Lake and southeast and south along the shoreline of Galveston Bay to Virginia Point. The MSC Superfund Site area and areas adjacent to the site to the north, west and south are shown as being primarily uplands.

The MSC Superfund Site is surrounded by a flood protection levee with only two potential off-site migration routes. The first of these routes is the vehicle gates located in the southwest and southeast corners of the MSC Superfund Site. The second outlet is a sealable stormwater gate and drainage pipe extending through the flood protection levee on the north side of the MSC Superfund Site.

The on-site Freshwater Pond contains an undetermined number of species of fish, numerous waterfowl (mostly seasonal), and an alligator.

The probable point of entry (PPE) from the groundwater to surface water migration pathway is the shortest straight-line distance within the aquifer boundary from the source at the MSC Superfund Site to the surface water. The PPE for the MSC Superfund Site is the northern tributary of the paleochannel crossing beneath the site where it enters Swan Lake and Galveston Bay. The distance from the earthen impoundment to the PPE is approximately 1250 feet. The eastern branch of the paleochannel extends to the southeast to Galveston Bay. The location where the eastern branch enters the bay is unknown.

2.8.4 Wildlife

Shorebird, songbird, waterfowl and raptors are known to migrate, winter and breed along the Texas Coast. These include federal and state endangered *Pelecanus occidentalis* (Brown Pelican), federal and state endangered/threatened *Falco peregrinus* (Peregrine Falcon), federal and state threatened *Charadrius melodus* (Piping Plover), and state threatened *Egretta rufescens* (Reddish Egret) and *Plegadis chihi (*White-faced Ibis). The Texas Colonial Waterbird Society has designated the Swan Lake Bird Rookery the shell islands that serve as a breeding ground for various gulls (subfamily Larinae), various herons and egrets (family Ardeidae), the Gull-Billed Tern (*Gelochelidon nilótica*), the Forster's Tern (*Stérna fórsteri*), and the Black Skimmer (*Rynchops nigra*). Within a 4-mile radius of the MSC Superfund Site, at least one Migratory Songbird Stopover Fallout site (Moody Ranch) has been identified. Fourteen bird rookeries have been identified within the 4-mile radius.

The Texas Parks and Wildlife Program, Texas Biological and Conservation Data System has listed five federal and state endangered species, one federal threatened and state endangered species, two federal and state threatened species and two state threatened species within a four-mile radius and 15-mile downstream distance of the MSC Superfund Site. These endangered and threatened species include the Leatherback Sea Turtle (*Dermochelys coriacea)*, the Atlantic Hawksbill Sea Turtle *(Eretmochelys imbricata imbricata)*, Kemp's Ridley Sea Turtle *(Lepidochelys kempii)*, the Loggerhead Sea Turtle *(Caretta caretta)*, and Green Sea Turtle *(Chelonia mydas).*

3.0 CONCEPTUAL SITE MODEL

This section discusses the potential exposure pathways and describes the development of the conceptual site model (CSM) for the MSC Superfund Site. The CSM conveys what is known about the sources, releases, release mechanisms, contaminant fate and transport, exposure pathways, potential receptors and risks. The CSM is a testable hypothesis that can be evaluated with field and laboratory data. Data collected during the RI will be used to verify, change and/or augment the model.

3.1 Exposure Pathways

Exposure pathways describe the environmental transport mechanisms by which potential receptor populations may contact chemical constituents present, or originating, from a site. An exposure pathway requires four necessary elements:

- a source and a mechanism for chemical releases to the environment (primary and secondary sources and release mechanisms);
- an environmental transport medium for the released chemical;
- a point of human or ecological contact with the medium;
- a human or ecological uptake route (ingestion, inhalation, or dermal contact) at the point of exposure.

Potential exposure pathways for both human and ecological receptors at the MSC Superfund Site include:

- dermal contact with on-site and off-site sediment;
- dermal contact with on-site surface water;
- dermal contact with surface and subsurface soil;
- incidental ingestion of on-site and off-site sediment;
- incidental ingestion of on-site surface water;
- incidental ingestion of surface and subsurface soil;
- ingestion of ecological prey that have ingested or accumulated contaminants by terrestrial receptors.
- ingestion of fish by human receptors;
- inhalation of volatile emissions from groundwater;
- inhalation of volatile emissions from on-site and off-site sediment;
- inhalation of volatile emissions from on-site surface water; and

- inhalation of volatile emissions from surface and subsurface soil.

Exposure pathways for the sludge contained within the earthen impoundment were not developed since the sludge is covered with water and direct human and ecological exposure is unlikely. Exposure to the surface water covering the sludge is possible for ecological and human receptors and will be considered in the surface water exposure pathway development.

The evaluation of a specific exposure pathway is based on contaminant mobility and behavior in the various affected media, as well as the release and migration mechanisms for the potential chemicals of concern (COCs), as discussed below.

3.2 Contaminant Mobility and Behavior

Potential COCs at the MSC Superfund Site can be released to air, soil, surface water, and groundwater. Data for the MSC Superfund Site groundwater, soils and sediments demonstrate releases from the site sources of aromatic and chlorinated VOCs, PAHs, and metals. Table 2 summarizes the maximum concentrations detected in wastes, groundwater and soils at the MSC Superfund Site. Analytical data for sludge in the impoundments indicate the presence of volatile and semivolatile organic compounds in concentrations ranging from 30 to 5000 mg/Kg. Groundwater concentrations of volatile and semivolatile organic compounds range from 0.050 to 2600 mg/L.

The chlorinated and aromatic VOCs and phenolic SVOCs exhibit high (>500 mg/L) solubilities. The other SVOCs generally have low to moderate solubilities in water (10 to 500 mg/L). The relatively high solubilities of the chlorinated and aromatic VOCs indicate that these compounds will preferentially dissolve into aqueous phases and be readily transported in groundwater. The PAHs generally have solubilities in the part per million range (< 1 mg/L). Vapor pressures for the SVOCs are less than 1 mm Hg, indicating low volatility, while the vapor pressures of the volatile compounds range from 1 to 100 mm Hg. The low vapor pressures and low Henry's Law constants (0.00001 to 0.01) for the semivolatile compounds suggest that volatilization from soil surfaces or from solution, will not readily occur.

3.3 Release and Migration Mechanisms

Transport of the potential COCs in environmental media is a function of the physical and chemical properties of the chemicals, the form in which the potential COCs were released, and the environmental conditions present at the MSC Superfund Site. These environmental conditions consist of a multi-component system at the MSC Superfund Site that includes air (ambient and soil gas), soil (unsaturated and saturated), groundwater, and surface water. The information and data presented in the PSCR are the basis for the CSM (URS 2004a), which is presented visually in Figure 7.

3.3.1 Primary Sources and Release Mechanisms

Three primary (sources with the largest volume of impacted media) sources of potential COCs have been identified at the MSC Superfund Site:

1. the Earthen Impoundment (including both the "Oil Pit" and the "Sludge Pit");
2. the API separators (Units 100 and 1200); and
3. the tanks.

Other potential sources (sources which may have released contaminants to soils and groundwater), such as the Closed Backwash Pit, the Laydown area in the northwest corner of the MSC Superfund Site, the distillation unit, ancillary piping, the filters and pumps associated with the injection wells, the laboratory sumps and the proposed decanning area, may have contributed to impacted soil and groundwater, the current data are inadequate to make a determination.

As shown on Figure 7, potential primary release mechanisms from these sources included:

- infiltration and percolation from the earthen impoundment, the Closed Backwash Pit and the slop oil pits;
- spills from the loading and unloading of wastes at the earthen impoundment, the API separators and the tanks to the MSC Superfund Site soil;
- discharges (overtopping) and stormwater runoff from the earthen impoundment;
- overfilling, spilling and leaking of wastes from process area operations (separators, distillation units, and injection wells) to surface soil and drainage ditches;
- leakage from ancillary piping to surface and subsurface soil.

The earthen impoundment was constructed in the paleochannel that transects the MSC Superfund Site. Wastes placed within the earthen impoundment and other potential sources were released to the groundwater through dissolution or sorption onto fine particulate matter. Once dissolved or sorbed, the chemicals would migrate with the groundwater through the preferential flow in the paleochannel.

Potential COCs within the waste liquids and sludge placed in the earthen impoundment, the API separators, and the tanks may have been released to the MSC Superfund Site soil by discharges (overtopping), spills or leaks to surface soil or may have migrated into MSC Superfund Site soil through infiltration or percolation (subsurface soil). Rain and surface water infiltration through impacted soil leaches the more water-soluble portions of the fluids resulting in the water-miscible fluids mixing with the groundwater and, depending on site characteristics, may migrate laterally.

Potential COCs residing in surface soil (0 - 2 feet), such as in the tank areas may be mobilized and transported by wind erosion, volatilization, or episodic surface runoff. These potential

COCs in surface soil may also migrate vertically to subsurface soil by desorption and leaching processes and may potentially enter groundwater.

Potential COCs in the groundwater may migrate by advection and dispersion via groundwater flow, volatilize to soil gas and ultimately disperse into the atmosphere, or become adsorbed to aquifer soils. Advection by means of groundwater flow may redistribute potential COCs to the shallow groundwater environment or transfer them to deeper aquifers. These potential COCs are subject to attenuation by chemical and biological degradation processes. The silt and sand in the vadose zone paleochannel increases the probability of impacted groundwater migration from the source to off-site receptors either in the marsh area between the MSC Superfund Site and Swan Lake or to the east (the closed Solutia South 20 waste disposal site).

3.3.2 Secondary Sources and Release Mechanisms

The primary releases may result in secondary sources: groundwater, on-site surface and subsurface soils and the on-site drainage ditches. Potential secondary release mechanisms from the soils at the MSC Superfund Site include:

- runoff from contaminated on-site soils to on-site surface water and on-site sediment;
- soil leaching to on-site groundwater;
- groundwater migration off-site; and
- discharge to off-site surface water and off-site sediment..

The mechanisms for releases from the sources, such as infiltration, percolation, advection and sorption, as discussed above also apply to the secondary sources.

3.4 Exposure Pathways and Receptors

Based on the information provided in the environmental reports and summarized in previous sections, the following potentially impacted media have been identified at the MSC Superfund Site:

- on-site and off-site sediments;
- on-site surface and subsurface soils;
- on-site surface water; and
- groundwater.

The potential for release of VOCs is high where the waste is potentially exposed to the atmosphere, such as in the Sludge Pit, and the Unit 100 and Unit 1200 API separators. Since the predominant wind direction is from the southeast, the population northwest of the MSC Superfund Site would be the potential receptors of air emissions. The Texas City Industrial Complex is northwest of the MSC Superfund Site.

3.4.1 Soil Exposure Pathway

The Unit 100, Unit 700, Unit 900, Unit 1100 and Unit 1200 areas are constructed on curbed concrete pads. The integrity of these concrete pads is unknown; therefore, the potential for releases to soils cannot be eliminated. The Unit 300, Unit 400, and Unit 800 tanks sit on native soil in areas bermed with native clay. The potential for releases to surface soils in these areas would be high. Depending on the subsurface stratigraphy, release potential to subsurface soils in these units would be low in areas constructed over the impermeable native clay, while the release potential to subsurface soils would be high in areas constructed over the paleochannel. Those units, such as the Sludge Pit and the Oil Pit, which are completed in the paleochannel, have a high release potential to soils and to groundwater.

3.4.2 Groundwater Exposure Pathway

Concentrations of metals, VOCs and SVOCs in the shallow groundwater-bearing unit indicate that groundwater has been impacted by releases from the MSC Superfund Site operations. These releases may have occurred from those units located above or within the paleochannel, such as the Unit 100 API separator and the earthen impoundment (the Sludge Pit and the Oil Pit).

No public water supply or domestic drinking water wells have been identified within a one-mile radius of the MSC Superfund Site (TNRCC 1998). One existing well reportedly drilled at the MSC Superfund Site in a deeper aquifer to supply water for site operations is located on the site near the Unit 700 injection well. GCWDA has one active fresh water supply well on-site. Water from this well is not used for drinking water purposes and the well is upgradient from the site (TNRCC 1998).

3.4.3 Surface Water and Sediment Exposure Pathway

Since the Freshwater Pond was excavated into the paleochannel, variations in the pond elevations correspond to variations in water levels of monitoring wells completed in the paleochannel demonstrating that the Freshwater Pond is hydraulically connected to groundwater. The pond collected stormwater runoff from areas of the facility and potentially may have accumulated contaminants. Contaminated on-site surface soils would drain to the on-site drainage ditches. Discharge/runoff from on-site drainage ditches was (and may currently be) channeled to the Freshwater Pond via the Laydown area or to off-site surface water and sediments through the stormwater discharge. If contaminants have accumulated within the pond, they may be released to groundwater and, depending on whether the hydraulic gradient from the Sludge Pit, Oil Pit and Unit 100 API separator is towards the pond, groundwater contaminants may be released to the pond.

3.4.4 Receptors

Figure 7 summarizes the selection of potential exposure pathways for evaluation in the RI/FS for the MSC Superfund Site. Multiple exposure routes for inhalation, ingestion, and dermal contact exist for each of the pathways listed above and for each of the types of receptors (human and ecological).

Human Health

The potential for exposure to residential receptors was not evaluated in the CSM. It is likely that restrictions on future development at the site, including restrictions against homes, hospitals, schools and day-care centers, will be placed on the property. No on-site residences exist and the closest off-site residential area (Bayou Vista) is approximately 1.5 miles away. Currently, the MSC Superfund Site is inactive. Activities, such as stormwater disposal and security patrol, occasionally occur on-site.

The site is abutted by the GCWDA Campbell Bayou Facility nonhazardous waste land disposal facility, the closed Solutia South 20 pre-RCRA landfill, and the Scenic Galveston land, which according to their literature, is a permanently deed restricted habitat conservation area. Scenic Galveston controls access to the MSC Superfund Site through an easement granted to the MCP.

Possible future site development, either as an industrial facility or as a nature preserve will potentially require the presence of industrial workers, construction workers and/or recreational users. These potential human receptors were included in the CSM.

Potentially complete on-site pathways for human receptors include inhalation of volatile compounds by industrial workers, construction workers or on-site recreational users from both groundwater and soil. Ingestion and dermal contact exposure pathways are not considered complete for on-site groundwater exposure to human receptors. These pathways are not considered complete exposure routes since the on-site water well does not provide potable water and is completed approximately 750-ft bgs. In addition, the TDS data (> 10,000 mg/L) for the shallow groundwater at the MSC Superfund Site and the adjacent Solutia South 20 waste disposal site indicate that this water would not be a source of potable water in the future. Drinking water regulations do not recommend the consumption of water with greater than 500 mg/L TDS (40 CFR 143.3). In addition, groundwater with greater than 10,000 mg/L of TDS is not considered an underground source of drinking water (40 CFR 146.3).

Incidental ingestion, inhalation of volatile compounds, and dermal contact to on-site surface soils are considered potentially complete exposure pathways to industrial workers and construction workers. In addition, inhalation of volatile compounds emanating from subsurface soils is considered a potentially complete exposure pathway to industrial workers and construction workers. Incidental ingestion and dermal contact with subsurface soils are considered potentially complete exposure pathways to construction workers.

Incidental ingestion, inhalation and dermal contact to on-site surface soils, on-site surface water and sediments are considered potentially complete exposure pathways to on-site recreational users. Inhalation of vapors from subsurface soils is considered a potentially complete exposure pathway to recreational users. Exposure to constituents in surface water and sediment in the Freshwater Pond may occur through dermal contact, incidental ingestion, inhalation of volatile constituents, and ingestion of fish that may have bioconcentrated/bioaccumulated constituents in surface water and sediments for on-site recreational users. While the earthen impoundment is not attractive to recreational anglers due to a lack of fish due to insufficient water depth to support a fish population of harvestable size, attempts may be made to access the impoundment for fishing. Therefore exposure to constituents in surface water may occur through dermal contact and inhalation of volatile constituents for on-site recreational users.

Off-site recreational users of the marsh area between the hurricane levee and Swan Lake may be exposed to constituents present in the sediments. Sediment in the marsh area may have been affected from stormwater runoff from the site or discharge of affected groundwater into the marsh area. Dermal contact and incidental ingestion may occur when the recreational user is wading in the marsh area. In addition, the off-site recreational user may be exposed to volatile constituents emanating from the sediments and to constituents that bioaccumulate/bioconcentrate by fish ingestion. Off-site surface water in the estuarine marsh is not considered in the BLHHRA because it is tidally influenced and contaminant concentrations in the surface water would not necessarily reflect influences from the MSC Superfund Site.

Ecological

Ecological receptors, both terrestrial and aquatic, are included in the conceptual site model. The location of the facility near an existing wildlife preserve and the presence of the Freshwater Pond and the off-site transitional zone (marsh area) between the MSC Superfund Site levee and Swan Lake indicate that the potential for exposure of both vertebrate and invertebrate species to site contaminants exists. Ingestion and dermal contact are considered potentially complete exposure pathways for fish in the water column and benthic invertebrates in the sediments in the Freshwater Pond and the marsh area. Avian receptors could include ducks and wading birds foraging in the Freshwater Pond and marsh area potentially exposing them to contaminants in the sediments and surface water and to contaminants that may have accumulated in vegetation or in prey items such as benthic invertebrates. Mammalian receptors such as raccoons could also be exposed to surface water, sediment, vegetation, and prey items. Reptiles and amphibians would be common to both aquatic areas and could be exposed to contaminants by ingestion as well as dermal contact.

The terrestrial areas are generally grassy areas with small trees, and provide habitat for a variety of avian, mammalian and soil invertebrate and plant communities. Surface soils are potentially the primary source of contaminants in the terrestrial areas, but certain contaminants could accumulate in terrestrial invertebrate tissues and plants. Terrestrial invertebrates and plants could be consumed by avian and mammalian receptors, thereby increasing the contaminant exposure to upper trophic level receptors. Reptiles and some amphibians could also be exposed to contaminants in the terrestrial areas.

Detailed ecological exposure pathways will be evaluated and a detailed CSM will be developed following the conservative benchmark screening in the screening level ecological risk assessment (SLERA). The detailed ecological exposure analysis will be developed using information on habitats, receptors, and contaminants identified during the RI. For example, information on fate and transport of contaminants identified in the SLERA will be reviewed in context with the ecological resources provided by the habitats and the receptors that utilize the habitats to focus the BERA. Since the SLERA is a simple comparison of site data to benchmarks there will be no pathway analysis. Once the SLERA is complete, and if necessary, MCP will define the data needs and develop and implement a work plan for a Baseline Ecological Risk Assessment (BERA).

4.0 PRELIMINARY REMEDIAL ALTERNATIVES

This section of the RI/FS Work Plan summarizes previous remedial responses for the MSC Superfund Site, the remedial action objectives for remedial units and the preliminary remedial alternatives developed in the PRAER (URS 2004b). The rationale for the preliminary remedial alternatives, with references to original data sources, is discussed in detail in the PRAER.

4.1 Remedial Responses

Closure plans have been developed for the MSC Superfund Site, primarily to address the Earthen Impoundment. These plans were not implemented or partially implemented. In addition, USEPA undertook an emergency response action in 1999 and 2000. This section of the report summarizes the closure plans and remedial responses at the MSC Superfund Site. This information is presented in detail, with references to original data sources, in the PRAER (URS 2004b).

4.1.1 Malone Services Company Response Actions

As part of the pre-RCRA corrective action, Malone Services Company proposed a cap and a slurry wall for the closure of the impoundments. It was proposed that the impoundments would be covered with permeable and impermeable liners and capped with soil. The weight of the soil cover would force liquids out of the impoundments and into the adjacent paleochannels where the liquids would be recovered and treated. The surface of the pit would then be graded to the present berm height. An impermeable slurry wall would be installed down-gradient from the Sludge Pit to seal the paleochannel from further contaminant migration.

As part of a Compliance Agreement with the TCEQ in January 1983, Malone Services Company began closure of the Sludge Pit and the Oil Pit. Considerable quantities of sand were placed in the eastern one-third and southwestern corner of the Sludge Pit and over the Oil Pit contents. Geotextile fabric was installed to cover the impoundment contents in both the Sludge Pit and the Oil Pit. Part of the closure actions performed by Malone Services Company included the installation of perimeter extraction wells and settlement gauges around both the Sludge Pit and the Oil Pit. A leachate collection system was also installed around the perimeter of the impoundment to recover water leaching up through the sand and geotextile.

The approval of the closure plan was voided by the Attorney General's office on April 2, 1986. Several months after closure activities ceased, the geotextile fabric in the Sludge Pit tore, thereby allowing waste material to flow to the top of some of the sand in the eastern one-third of the sludge pit. According to Environmental Consulting Associates (ECA) the southwestern corner of the Sludge Pit is depressed, which allows rainwater to collect. There has also been substantial settling of the surcharge material in the Oil Pit. URS's observations are that currently the entire Sludge Pit is topped with water with only some floating geotextile material emergent at one small location near the west central end of the impoundment. During prolonged periods of low precipitation, the underlying sludge may be uncovered by water.

On March 1989, ECA submitted a FS and closure plan for the earthen impoundment on behalf of Malone Services Company to TCEQ for review (ECA 1989). A request for authorization to perform pilot studies was also submitted as part of the closure plan. The closure alternatives evaluated by ECA included:

- no action;
- containment using a liner or cap;
- treatment methods including incineration, biological/aeration, solidification, and dewatering; and
- disposal methods including deep well injection and landfill burial.

After evaluating the closure alternatives, ECA recommended a closure plan that included three treatment steps:

- aeration/biodegradation
- dewatering
- solidification

The aeration/biodegradation phase of the plan proposed the installation of surface aerators and continually aerating the waste material with periodic additions of a microbial culture and water to promote biodegradation of the waste. During the dewatering phase, the aerated waste material would be pumped into a settling basin and subjected to a mechanical consolidation process to reduce the overall waste volume. The consolidation process was to be performed by continually mounding and remounding the waste material using a crane mounted dragline bucket. The liquid waste from the treatment would be disposed of on-site in the permitted deep well injection facility. In the final phase, ECA proposed solidification of the remaining sludge with a 10% to 20% mixture of fly ash. The solid residuals from the treatment would be disposed of in a capped and lined at-grade landfill. A synthetic membrane liner would also be incorporated into the plan to provide storage and curing space for the solidified waste material and to act as a barrier for further migration of the waste off-site. A low permeability clay cap would be placed over the impoundment.

A treatability study on aeration/biological degradation and aeration/settling for the impoundment waste was also included in the Draft Feasibility and Closure Plan. Waste sample and water mixtures were used for the aeration/biological degradation study. The waste sample was obtained from the Sludge Pit at three different depth intervals, which were assumed to be representative of the upper, middle, and lower portions of the waste. The samples were then placed in tanks and aerated with diffused air aerators. A microbial culture was added to each of the tanks after aeration began. The results indicated that aeration and biological degradation were effective in reducing the chemical oxygen demand (COD) concentrations by 60% after 14 days and 80% after 35 days. There was no difference in response between the upper, middle, and lower zones of the waste material.

For the aeration/settling study, the waste samples obtained from the same depth intervals as the biodegradation study were mixed with water, aerated for different specified aeration intervals, and allowed to settle quiescently. The settling characteristics of each of the samples were measured visually. Volume reductions of 15% to 40% in the solid waste were observed. The upper zone benefited the most from aeration/settling compared to the middle and lower zones. These studies are not considered accurate by URS for the proposed treatability purposes because they did not test the settleability of sludge previously treated by biodegradation, as outlined in the treatment sequence. URS's concerns with the test methods does not indicate a conclusion that the outlined treatment process could not work, but that the testing was not performed appropriately to demonstrate the true outcome of the proposed treatment.

The TCEQ reviewed the FS and closure plan and responded (TWC 1989) with several concerns regarding the closure plan:

- compliance with "Land Ban" restrictions;
- lack of data on the waste streams;
- liner strength;
- cap design; and
- performance standards (remedial action objectives).

The proposed closure plan involved the removal, treatment, stabilization, and placement of waste back into the impoundment. The agency felt that the removal, treatment, and placement of the waste invoked the "Land Ban" restrictions, which prohibit the redeposition of treated wastes into units from which they were removed. The TCEQ stated that Malone Services Company would have to either petition EPA for an exemption, waiver, or variance or obtain authorization from EPA that the proposed treatment would meet all applicable federal regulatory standards.

The agency was also concerned with the lack of information on whether the characteristics of the waste stream would limit microbial degradation of the wastes during the aeration/biodegradation treatment process and that some of the unsolidified waste material could potentially contaminate the groundwater. The agency questioned if the 20-ml HDPE liner proposed by ECA could withstand the tensile stress of the waste material and weight of construction equipment. The closure plan did not provide sufficient technical information for the cap design and installation. Preliminary calculations performed by the agency indicated that the proposed cap design did not meet the agency technical guidelines for capping hazardous waste landfills. The TCEQ noted that no performance standards were given for all the treatment processes specified in the proposed closure plan.

The agency authorized the performance of pilot studies by ECA to determine in-situ aeration equipment and air requirements and to optimize the aeration, dewatering, and solidification processes. Data for the pilot studies have not been located by URS.

On February 8, 1993, Malone Services Company submitted a submitted a proposal for the use of a closed system thermal treatment unit in the closure of the earthen impoundment. This thermal unit reportedly would volatilize and capture the alcohols [*sic*] in the waste and allow the separation of aqueous, oily, and solid phases of the waste. The solid phase would be stabilized and disposed of, while the oily phase would be used to fuel the thermal unit, and the aqueous phase would be injected into a deep injection well. TCEQ approved this closure proposal on March 12, 1993 and requested a formal closure plan. Data supporting this process have not been located by URS.

4.1.2 USEPA Response Actions

The Superfund Technical Assessment and Response Team (START) conducted an emergency response action in April and May 2000. Approximately 1,767,196 gallons of material were removed from the tanks with approximately 1,987,807 gallons of solids and sludge remaining in the tanks. In addition, WDW-138 was rehabilitated during November 1999 using a well cleanout and acid wash (E&E 2000). Approximately 3,227,867 gallons of tank liquids and stormwater were disposed of in the well between December 1999 and May 2000.

A filter press was designed and installed to dewater sludge in Unit 1200. Attempts to dewater the sludge with various amendments were unsuccessful and the operation was terminated in January 2000. The lime-sludge mixture of about 30 – 35% originally formulated for dewatering the sludge had to be reformulated because the composition of sludge in the four cells of Unit 1200 was different. Pre-treatment methods were evaluated for enhancing solid filter cake production from dewatering the sludge, including ferric chloride, ferric sulfate and diatomaceous earth, and the installation of a boiler and steam heat system. These methods proved ineffective.

Approximately 450 cubic yards (yd^3) of material were dewatered in Unit 1200 during the process. The loose solids in the Unit 1200 drying pit were solidified in-situ with lime and 29 roll-off boxes of filter press wastes were sent to a Class 1 non-hazardous landfill in March 2000. The sludge remaining in the other cells was redistributed and the surface liquid was pumped into an oil-water separator to allow suspended solids to settle. The separated liquid was injected into the deep well. The solids were returned to Unit 1200. The filter press units and associated equipment were decontaminated, dismantled, and demobilized by February 2000.

Approximately 2,025 yd^3 of sludge were dewatered in the Unit 100 surface impoundment using a 30% mixture of quicklime. The solids were placed on-site, covered with a plastic liner and surrounded by a one-foot high clay berm. The earthen containment around T804, which had high levels of petroleum hydrocarbons, was solidified in-place with lime. Data on the success of this treatment was not provided in the removal assessment report.

START was also tasked by the USEPA Region 6 Response and Prevention Branch to conduct removal assessment activities at the MSC Superfund Site. START inventoried the laboratory contents, the contents and condition of 85 buckets and cans and 34 drums. Container samples were screened using field hazard categorization techniques to identify potentially RCRA hazardous materials. The team documented the presence of 117 aboveground storage tanks; 31 contained a total estimated volume of 4.1 million gallons of waste materials. The remaining tanks reportedly were empty.

START reportedly also removed sediments/soils from the drainage ditches and disposed of this material off-site (Zehner 2004).

4.2 Remedial Action Objectives

In order to facilitate the selection of preliminary remedial alternatives, the site has been divided into remedial units. The remedial units were selected based upon the media, the types of contaminants, and the exposure scenario: groundwater, sludge and liquid wastes, on-site surface and subsurface soils, on-site and off-site sediments. Surface water was not considered a remedial unit because remedial action objectives for sediment/sludge will effect a remedy of the surface water. The sludge and liquid wastes remedial unit includes material contained within the primary sources, the earthen impoundment, API separators, tanks, pits, and sumps. Structures were not included in the remedial units since they belong to the property owner. Sludge and liquid wastes remaining within structures such as tanks, sumps, or buildings are included in the sludge and liquid wastes remedial unit.

Remedial action objectives provide medium-specific (or remedial unit specific) goals for protecting human health and the environment. Using the CSM information discussed above, remedial action objectives were developed for each remedial unit.

4.2.1 Groundwater

The remedial action objectives for groundwater are to:

- mitigate inhalation of carcinogenic and non-carcinogenic contaminants by site workers and recreational users to agreed risk-based cleanup levels;
- restore groundwater to agreed risk-based cleanup levels protective of ecological exposure to off-site surface water and sediments in the transitional zone (marsh area) between the site levee and Swan Lake; and
- mitigate further migration of the most-contaminated groundwater to off-site properties.

4.2.2 Sludge and Liquid Wastes

The remedial action objectives for sludge and liquid wastes are to:

- mitigate direct contact/inhalation of carcinogenic and non-carcinogenic contaminants to agreed risk-based cleanup levels by on-site recreational users;
- mitigate the release of carcinogenic and non-carcinogenic contaminants to agreed risk-based cleanup levels from sludge and liquid wastes to surface soils and sediments;
- mitigate migration of carcinogenic and non-carcinogenic contaminants from sludge and liquid wastes to groundwater to agreed risk-based cleanup levels for inhalation from groundwater contaminants by site workers and on-site recreational users;
- mitigate the release of contaminants from sludge and liquid wastes to surface soils and sediments to agreed ecological risk-based cleanup levels; and
- mitigate the release of contaminants from sludge and liquid wastes to surface water to agreed ecological risk-based cleanup levels.

4.2.3 On-Site Soils and Sediments

The remedial action objectives for on-site soils and sediments (remedial action objectives for sediments assumed to effect remedy of surface water as well) are to:

- mitigate ingestion/direct contact/inhalation by site workers and on-site recreational users of carcinogenic and non-carcinogenic contaminants from surface soils to agreed risk-based cleanup levels;
- mitigate inhalation by site workers and on-site recreational users of carcinogenic and non-carcinogenic contaminants from subsurface soils to agreed risk-based cleanup levels;
- mitigate direct contact/ingestion by site construction workers to carcinogenic and non-carcinogenic contaminants in subsurface soil;
- mitigate ingestion/direct contact/inhalation by on-site recreational users of carcinogenic and non-carcinogenic contaminants from sediments to agreed risk-based cleanup levels;
- mitigate ingestion (fish) by recreational users of carcinogenic and non-carcinogenic contaminants from sediments to agreed risk-based cleanup levels; and
- mitigate migration of contaminants to groundwater from on-site soils and sediments to agreed risk-based cleanup levels for the prevention of inhalation of contaminants by site workers and recreational users.
- mitigate ingestion by terrestrial ecological receptors of contaminants from surface soils to agreed risk-based cleanup levels;

- mitigate ingestion by terrestrial and aquatic receptors of contaminants from sediments to agreed risk-based cleanup levels;
- mitigate the ingestion (fish) by terrestrial receptors of contaminants from sediments to agreed risk-based cleanup levels; and
- mitigate migration of contaminants to surface water to agreed ecological risk-based cleanup levels.

4.2.4 On-Site Surface Water

The remedial action objectives for on-site surface water are to:

- restore surface water to agreed risk-based cleanup levels protective of on-site recreational users (assumed to be the maximally exposed individual thus being protective of all human receptors) from carcinogenic and non-carcinogenic contaminants in the Freshwater Pond and the Earthen Impoundment; and
- restore surface water to agreed risk-based cleanup levels protective of ecological exposures in the Freshwater Pond.

4.2.5 Off-Site Sediments

The remedial action objectives for the off-site sediments in the transitional zone (marsh area) between the MSC Superfund Site levee and Swan Lake are to:

- mitigate ingestion/direct contact/inhalation of carcinogenic and non-carcinogenic contaminants from sediment by off-site recreational users to agreed risk-based cleanup levels;
- mitigate ingestion of fish by off-site recreational users of carcinogenic and non-carcinogenic contaminants to agreed risk-based cleanup levels; and
- mitigate migration of contaminants to groundwater from off-site sediments to agreed risk-based cleanup levels for the prevention of inhalation of contaminants by off-site recreational users.
- mitigate ingestion by terrestrial and aquatic receptors of contaminants from sediments to agreed risk-based cleanup levels;
- mitigate dermal contact by aquatic receptors of contaminants from sediments to agreed risk-based cleanup levels;
- mitigate migration of contaminants to surface water to agreed ecological risk-based cleanup levels; and
- restore sediments to agreed ecological risk-based cleanup levels.

4.3 Preliminary Remedial Alternatives

The RI/FS Work Plan will discuss in this section remedial alternatives that were developed in the PRAER (URS 2004b). These remedial alternatives comply with the National Contingency Plan (NCP) requirements that containment, treatment and no-action alternatives be developed and considered in the FS (USEPA 1988). The PRAER did not eliminate the evaluation of other remedial alternatives during the FS if data developed during the RI indicate that other technologies may be more suitable for the site contaminants. The preliminary remedial alternatives were selected using data and experience from the MSC Superfund Site and from other Superfund or related waste sites with similar settings, histories, and contaminants to eliminate remedial alternatives.

Affected media at the MSC Superfund Site include sludge and waste materials located in the pits, API separators and tanks at the site as well as groundwater. Potentially affected media include on-site soils and sediments, and the sediment in the transitional zone (marsh area) located off-site between the flood protection levee and Swan Lake. A proposed remedy for Swan Lake was not included in this document because a remedy for this water body was implemented in Operable Unit 4 of the TexTin Superfund Site.

Four details unique to the MSC Superfund Site were considered during the development of the preliminary remedial alternatives. (1) The MSC Superfund Site has considerably more waste material potentially requiring treatment than other Superfund sites evaluated in this document; up to 350,000 yd^3 versus 59,100 to 76,000 yd^3. (2) PCBs, which limited the remedial options for other Superfund sites, have not been detected in waste or soil samples. (3) The MSC Superfund Site has an underground injection well, which is currently operated under a TCEQ and USEPA approved Stormwater Management Plan and an Operations and Maintenance Plan for Stormwater Management, is available for incorporation into the remedies. Injection wells, as a component of a remedial alternative, was considered for three sites, but eliminated due to the costs of disposal at a commercial underground well injection facility. (4) The MSC Superfund Site is already protected with a hurricane levee, gate(s) and a drainage system capable of controlling off-site stormwater drainage.

4.3.1 Sludge, Waste Materials, and Soils

Potentially suitable treatment alternatives for the waste materials at the MSC Superfund Site included incineration, solidification/stabilization, bioremediation, while suitable containment alternatives include an on-site cap or off-site disposal in a landfill.

The no-action alternative for the sludge and waste materials at the MSC Superfund Site was evaluated and eliminated as a potential remedy. The presence of the sludge and waste materials requires access to the site be limited to minimize exposure to public health and prevents redevelopment of the property. The sludge and waste materials, due to their presence in one or more impoundments within a permeable paleochannel, provide a continuing source for the migration of chemical contaminants to groundwater. The presence of sludge and wastes within the pits and impoundments poses a potential threat to ecological receptors that may enter or otherwise use the pits for shelter or food sources.

The recommended preliminary remedial alternative for sludge, wastes and soils has several components:

1. bioremediation of the sludge in the Sludge and Oil Pit, API separators and tanks to reduce volume and toxicity.
2. injection of the treated related water into the underground injection well.
3. solidification and stabilization of the residuals in the sludge pit.
4. capping the solidified/stabilized residuals, possibly along with contaminated soils, and
5. maintenance of the existing hurricane levee and controlled stormwater drainage system.

The limited soils data for the site indicate that soil contaminants are primarily hydrocarbon-related chemicals such as PAHs. Assuming this chemical profile is confirmed during the RI, three alternatives for soils contaminated above risk levels are proposed. The appropriate alternative will be identified based on the volume of material requiring treatment and the concentrations of the contaminants.

1. in-situ treatment of soils (e.g., landfarm) followed by covering the treated soils with a soil cap;
2. excavation and incorporation of the soils into the sludge and waste bioremediation systems; or
3. excavation and consolidation of the soils with the solidified/stabilized residuals, and
4. maintenance of the existing hurricane levee and controlled stormwater drainage system.

The following activities are recommended during the RI/FS to identify the suitability of the preliminary remedial alternative for the sludge, wastes and soils:

1. obtain samples of wastes and sludge from the Oil Pit, Sludge Pit, API separators, and tanks and conduct biotreatability studies.
2. determine mixing protocol and specifications for residual sludge and waste treatment.
3. sample surface soils (0-6”) within the Laydown area, the undeveloped area south of the offices and earthen impoundment, the decanning area, the tanks, and the area south of the Unit 1200 API separator.

4.3.2 Groundwater

Potential treatment alternatives suitable for the groundwater at the MSC Superfund Site include pump and treat, MNA, and bioremediation, while suitable containment alternatives include a vertical barrier wall and deep well injection.

Four elements were significant to the development of a preliminary remedial alternative for the groundwater unit at the MSC Superfund Site. (1) Historical data, though approximately 10 years old, indicate that impacted groundwater has not advanced beyond the site boundaries. (2) The site is relatively isolated and drinking water wells are not located within one-mile of the site. (3) An aggressive remedy has been recommended for the sludge, wastes and soils at the site. (4) The site's underground injection well, which is currently operated under a TCEQ and USEPA approved Stormwater Management Plan and an Operations and Maintenance Plan for Stormwater Management, is available for incorporation into the remedies.

The no-action alternative for the groundwater at the MSC Superfund Site was evaluated and eliminated as a potential remedy. Even if impacted site groundwater is still contained within the site, there is no guarantee that already impacted groundwater will not migrate off-site.

The preliminary remedial alternative recommended in the PRAER for groundwater has three components:

1. installation of a slurry wall in the paleochannels on either side of the Sludge Pit.
2. maintenance of an inward gradient by pumping the groundwater inside the slurry wall and injection of the treated water into the underground injection well.
3. monitored natural attenuation of groundwater outside the slurry wall.

The following activities were recommended during the RI/FS to identify the suitability of the preliminary remedial alternative:

1. determine the extent of horizontal migration in the first transmissive zone by sampling all on-site monitoring wells for metals, SVOCs, and VOCs.
2. verify the boundaries of the paleochannel by determining the stratigraphy using cone penetrometer tool techniques.
3. develop geotechnical data for slurry wall placement using the cone penetrometer tool (CPT) techniques, intact cores, or other methods as needed for slurry wall design and placement.

4.3.3 Sediments

The only identified treatment alternative for the site is bioremediation of sediments containing organic compounds exceeding risk-based criteria. Containment alternatives suitable for the MSC

Superfund Site include dredging and disposal in the capped area or in-situ capping using passive or active siltation.

Two elements were significant to the development of a preliminary remedial alternative for the MSC Superfund Site. (1) Sediments in the on-site ditches were excavated during the START activities (Zehner 2004). (2) The existing remedial action for Swan Lake was recently completed as part of the TexTin Superfund Site Operable Unit 4 (Puga 2004).

The no-action alternative for the sediments at the MSC Superfund Site was evaluated and retained as a potential remedy. Since on-site sediments were removed by the USEPA, additional remediation activities may not be warranted. Off-site sediments in Swan Lake are currently being remediated by the TexTin remedy and thus no further action is required for those sediments.

The recommended preliminary remedial alternative for sediments has two components:

1. no action for on-site sediments.
2. natural siltation for off-site sediments in the transitional zone (marsh area) between the flood protection levee and Swan Lake.

The following activities were recommended during the RI/FS to identify the suitability of the preliminary remedial alternative:

1. augment the sediment data from the SSI (TNRCC 1998) with additional samples from the marshy area adjacent to the storm water discharge and from the on-site drainage ditches.
2. assess the presence and bioavailability of metals in the pond and, if needed, the pond and the off-site area near the stormwater discharge using acid volatile sulfide-simultaneously extracted metals and total metals analyses.

5.0 WORK PLAN RATIONALE

This section of the RI/FS Work Plan presents the rationale for the site RI. The data obtained during the RI should be of sufficient quality to support the human health and ecological risk assessments as well as an evaluation of the remedial alternatives presented in the PRAER. The MCP are undertaking a “Triad” approach to the RI. The three components of the Triad are:

- systematic planning,
- dynamic work plans, and
- on-site analyses, data interpretation and data management.

The Triad is implemented to streamline the site investigation and to minimize mobilizations to gather additional data. However, it can be unrealistic to expect that a complicated site can be investigated in one mobilization; this would require unnecessary expenditures of time and money to gather data that may not enhance the understanding of the site. Additional mobilizations may be necessary to obtain data to refine the CSM, to complete the human health and ecological risk assessments, and to define the remedial alternatives.

5.1 Triad Approach

The goal of the project is to characterize the MSC Superfund Site with respect to the:

1) nature and extent of contamination;

2) risk to human health and the environment; and

3) treatability of waste materials.

The nature and extent of contamination will be characterized by representative sampling of the various environmental media including surface and subsurface soils, groundwater, on-site and off-site sediments, and on-site surface water. Representative samples of waste materials will be collected for treatability studies. The major goal of this project is to characterize impacted areas sufficiently to evaluate whether the risk in the impacted areas is sufficient to require corrective actions. Another goal of this project is to sufficiently characterize waste materials and impacted media to determine appropriate remedial technologies for the media.

The goals will be met by utilizing a triad approach that includes systematic planning, dynamic work plans, and on-site analyses, rapid sampling tools, and on-site data management and interpretation. The dynamic work plan utilizes real-time data to reach decision points. The third component of the Triad approach utilizes on-site analyses, rapid sampling tools and on-site data management and interpretation. Figure 8 depicts the logic of the Triad approach to the RI.

5.2 Data Quality Objectives

The systematic planning process began with the development of the CSM in the PSCR. The CSM was refined in the PRAER and will continue to be refined during the planning process. The CSM serves as the testable hypothesis for the site. Data quality objectives (DQO) developed as part of the systematic planning process define the quality of the data to meet the needs of the hypothesis testing, as well as for the human health and ecological risk assessments, and remedy evaluation. The details of the DQO process are documented in the QAPP (Appendix B).

DQOs for this site characterization have been developed in general accordance with the guidance in "Data Quality Objectives for Hazardous Waste Site Investigations" (USEPA 2000). The seven steps advocated by the USEPA are:

1. State the problem.
2. Identify the decision.
3. Identify inputs to the decision.
4. Define the boundaries of the study.
5. Develop a decision rule.
6. Specify tolerable limits on decision errors.
7. Optimize the design for obtaining data.

5.2.1 Step 1: State the Problem

The most important activities in this step are to:

1. Establish the planning team;
2. Describe the problem; and
3. Identify available resources, constraints, and deadlines.

Establish the Planning Team

The planning team is composed of project management and technical staff from USEPA, the MCP, and URS. The Project Management Plan is contained within Section 8.0 of the RI/FS Work Plan. Critical project decisions and decision-making logic are defined in the SAP. The project management section of the RI/FS Work Plan describes the decision level authority and communication. Project management team members have been designated as members of the project decision-making team and as technical expertise support. Lines of communication are established between field staff, project management, the MCP and USEPA to convey data from the field to decision-makers and to convey decisions back to the field staff. These lines of communication are described in the Project Management Plan (Section 8).

Describe the Conceptual Site Model

The CSM conveys what is known about the sources, releases, release mechanisms, contaminant fate and transport, exposure pathways, potential receptors and risks. The CSM is described in detail in Section 3.0 of the RI/FS Work Plan, as well as in the BLHHRA Work Plan and in the ERA Work Plan. Data collected during the RI will be used to verify and/or augment the model. The remedial action objectives discussed in Section 4.0 and the data quality objectives are developed from the CSM.

Sampling, field screening and laboratory analytical protocols appropriate for both the COCs and the impacted media are identified in the FSP and QAPP.

Identify Available Resources, Constraints, and Deadlines

During the systematic planning, a field activity schedule was devised for early sample collection in areas that can aid in decision-making. Several critical field activities were identified. The outcome of these critical field activities may impact the scope and extent of other site investigation tasks. The critical field activities are the site-wide groundwater assessment, additional delineation of the paleochannel, vertical demonstration of a competent clay barrier beneath site and paleochannel, and the collection and analysis of soil samples in the Laydown Area.

The available resources include the project management, technical staff, and drilling and environmental laboratory contractors. Site characterization must be conducted in accordance with the SAP and RI/FS Work Plan.

5.2.2 Step 2: Identify the Decision

The essential components of this step are to:

1. Identify the principal study questions;
2. Define alternative actions; and
3. Develop decision statements.

Identify Principal Study Questions

The principal study questions may be stated as:

Do concentrations of COCs in on-site surface soils in non-operating units exceed site-specific risk-based criteria established for human or ecological receptors?

Do concentrations of COCs in on-site surface soils in operating units exceed site-specific risk-based criteria established for human receptors?

Do concentrations of COCs in on-site subsurface soils in operating units exceed site-specific risk-based criteria established for human receptors?

Do concentrations of COCs in on-site surface water exceed site-specific risk-based criteria established for human or ecological receptors?

Do concentrations of COCs in on-site or off-site sediments exceed site-specific risk-based criteria established for human or ecological receptors?

Do concentrations of COCs in groundwater at the site perimeter exceed site-specific risk-based criteria established for human receptors?

Does the subsurface stratigraphy support the presence of protective confining clay?

Do the physical and chemical characteristics of the sludge, waste materials and heavily impacted soils support the ability to implement the preliminary remedial alternatives?

Define Alternative Actions

The alternative actions that could result from the resolution of the principal study questions are to recommend that portions of the site (i) require no further evaluation or selection of a remedy; or (ii) warrant additional assessment or selection of a remedy. These alternative actions apply to on-site surface water, on-site and off-site sediments, surface soil, and subsurface soil. The alternative actions for groundwater are to recommend that (i) data support the selection of a remedy or (ii) additional horizontal or vertical assessment is needed. The alternative actions for sludge, waste materials, and heavily impacted soils are to recommend that (i) data support the selection of a remedy or (ii) alternate remedies must be evaluated.

Develop Decision Statements

The principal study question and the alternative actions are combined into the following decision statements.

Determine whether COC concentrations in perimeter groundwater exceed site-specific risk-based human health and ecological (if applicable) criteria and warrant off-site assessment, or whether the COC concentrations are equal to or less than site-specific risk-based human health and ecological (if applicable) criteria and the preliminary remedial alternatives can be implemented.

Determine whether subsurface stratigraphy supports the presence of a protective confining clay, or whether the investigations of the second transmissive zone are warranted.

Determine whether COC concentrations in on-site surface soils in non-operating units exceed site-specific risk-based human health or ecological criteria and warrant additional investigations or a response action, or whether the COC concentrations are equal to or less than site-specific risk-based human health or ecological criteria and the on-site surface soils in operating units require No Further Action.

Determine whether COC concentrations in on-site surface soils in operating units exceed site-specific risk-based human health criteria and warrant a response action, or whether the COC concentrations are equal to or less than site-specific risk-based human health criteria and the on-site surface soils in operating units require No Further Action.

Determine whether COC concentrations in on-site subsurface soils in operating units exceed site-specific risk-based human health criteria and warrant a response action, or whether the COC concentrations are equal to or less than site-specific risk-based human health criteria and the on-site subsurface in operating units require No Further Action.

Determine whether COC concentrations in on-site surface water exceed site-specific risk-based human health or ecological criteria and warrant additional investigation or a response action, or whether the COC concentrations are equal to or less than site-specific risk-based human health or ecological criteria and the surface water require No Further Action.

Determine whether COC concentrations in on-site and off-site sediments exceed site-specific risk-based human health or ecological criteria and warrant additional investigations or a response action, or whether the COC concentrations are equal to or less than site-specific risk-based human health or ecological criteria and the sediments require No Further Action.

Determine whether physical and chemical characteristics of sludge, waste materials, and heavily contaminated soil support the presumptive remedy or whether the physical and chemical concentrations require the selection of other presumptive remedies.

5.2.3 Step 3: Identify Inputs to the Decision

In Step 3 of the DQO process, the information needed to resolve the decision statement is identified, including decision values and analytical methodology. The following components of this step are addressed:

1. Identify the information needed;
2. Determine the sources of the information;
3. Determine the basis for the action levels; and
4. Identify sampling and analysis methods that can meet the action levels.

Identify the Information Needed

Obtaining an early, full characterization of groundwater from existing monitoring wells is critical to determining the current status of groundwater. Once the current extent of impacted groundwater is understood, the need for and nature of an additional groundwater investigation can be identified. The groundwater status is also critical to the soil investigations, as a potential indicator, along with the groundwater gradient data, of whether there are large and/or apparent impacts on groundwater across the site or in more localized settings on the site. Soil boring locations may be added or modified if the impacted groundwater appears to extend beyond or be confined to a specific location, investigation unit, or area of the property.

Infilling of the previous boring program (Law 1982) to thoroughly demonstrate whether additional unknown significant paleochannel branches exist is critical to separating areas of potential releases to the paleochannel groundwater from areas with minimal risk due to the presence of a competent underlying clay. This should minimize the need for additional well locations or other groundwater samples within areas underlain with competent, confining clay.

Similarly, to minimize the need for extensive evaluations of the vertical extent of releases detected in either the paleochannel or the clay areas, an early program for delineating the extent of the clays beneath the site and the paleochannel needs to be implemented to eliminate that pathway, if possible.

Another critical task is the sequence of soil samples. The Laydown Area will be sampled prior to other locations in order to gather data on the correlation of field immunoassay and laboratory analytical results. Based on this correlation, the appropriate field analytical procedures will be implemented during the soil sampling program.

The information needed to resolve the principal study questions are field screening results, the analytical results, and the site-specific human health or ecological screening levels for soils and groundwater. Exceedences of the screening levels by any constituent will result in the generation of a second site-specific risk-based criterion required to resolve the principal study questions. Details of the field screening requirements and the analytical requirements are discussing in the QAPP.

Determine the Sources of the Information

Site-specific information will be obtained from field screening and fixed laboratory analytical data. The QAPP discusses the choices of field screening procedures and the fixed laboratory analytical procedures. On-site data management and interpretation are described in the Data Management Plan (Appendix D). On-site analyses are described in the FSP and quality control requirements for the on-site analyses are listed in the QAPP.

Determine the Basis for the Action Level

The action levels for the project are conservative risk-based screening levels published by USEPA Region 6 and the Texas Commission on Environmental Quality (TCEQ). These action levels are not intended as target remediation criteria. Rather the action levels will be used to determine the need for additional sampling activities in areas that may exceed the conservative criteria, and therefore, may present a risk to ecological or human receptors.

Identify Sampling and Analysis Methods that can meet the Data Requirements

SOPs that describe suitable protocols for sampling surface soils, sediments and surface water are contained in the FSP. Sampling protocols are described in the FSP. Appropriate analytical methods are described in the QAPP.

In order to facilitate the RI, the field activities have been divided into site-wide and area-specific investigations. The sections below describe the two types of investigations, the portions of the site that will be investigated, critical project decisions, the applicable DQO decision statements, on-site measurements and the general approach to obtaining the data. The FSP and QAPP provide the detailed investigation approach for each investigation area.

5.3 Site-Wide Investigation

The site-wide investigation assesses the nature and extent of impacted groundwater. Impacted groundwater was identified initially in the TCEQ 1986 sample event. The extent of impacted groundwater was investigated by MSC in 1994 and confirmed by the TCEQ during the 1997 SSI. The various investigation reports summarized in the PSCR described how the boundaries of the paleochannel direct and confine the impacted groundwater.

5.3.1 Horizontal Delineation of Groundwater

The first critical decision for the groundwater is stated as "Has the impacted groundwater been delineated horizontally?" This critical decision has been incorporated into the decision statement for the horizontal delineation of impacted groundwater as derived in the DQO section of the QAPP:

"Determine whether COC concentrations in perimeter groundwater exceed site-specific risk-based human health and ecological (if applicable) criteria and warrant off-site assessment, or whether the COC concentrations are equal to or less than site-specific risk-based human health and ecological (if applicable) criteria and the preliminary remedial alternative can be implemented."

Sampling the wells for metals, SVOCs, and VOCs will identify the current status of impacted groundwater. If, as described in the decision statement, perimeter well COC concentrations exceed screening levels, additional investigative activities may be implemented. These may include sampling direct push borings for groundwater or installing temporary or permanent monitoring wells.

A stratigraphic investigation tool, the CPT, will be used to provide data for delineating the boundaries of the paleochannel. If additional groundwater assessment is warranted, the CPT data will also provide information for the placement of new groundwater sample locations. If additional groundwater assessment is not warranted, then the CPT data defining the boundaries of the paleochannel and the presence/absence of side channels will be used to support the decision. The CPT data will also be sued to support the engineering design for the groundwater remedy.

The SAP describes the specific activities for obtaining the data for horizontal groundwater delineation, including proposed sample locations in the FSP and data quality requirements in the QAPP. Since many of the COCs are projected to have low risk-based screening numbers and high quality data is needed for the decision, on-site analyses are not planned. The FSP also describes procedures for installing temporary and permanent monitoring wells if the project team decides that additional data is necessary to characterize impacted groundwater.

5.3.2 Vertical Delineation of Groundwater

The second critical decision for the groundwater is stated as "Has the impacted groundwater been delineated vertically?" In lieu of sampling the second transmissive zone, this question will be answered indirectly by obtaining subsurface stratigraphic data. This critical decision has been incorporated into the decision statement for the vertical delineation of impacted groundwater as derived in the DQO section of the QAPP:

"Determine whether subsurface stratigraphy supports the presence of a protective confining clay, or whether the investigations of the second transmissive zone are warranted." The data for this determination will be obtained from logging the Unit 700 non-potable well, reviewing regional and local well logs, logging borings installed to obtain samples for chemical analyses, and analyzing samples for geotechnical parameters. The SAP describes the specific activities for obtaining the data for this determination, including proposed sample locations in the FSP and data quality requirements in the QAPP.

5.4 Area-Specific investigations

The area-specific investigation focuses on determining if soils have been impacted, and if necessary, vertical and horizontal delineation of impacted soils. Information from facility operations and previous investigations that was compiled in the PSCR, as well as site walks, has been incorporated into the identifying areas of the facility that are similar. The facility is divided into investigation units, or areas using the following criteria:

- operating history,
- aerial photographs,
- obvious impact from visual observations,
- risk before implementing any remedy, and
- risk after implementing a remedial alternative.

The operating history is described in detail in the PSCR and summarized in this work plan. Preliminary remedial alternatives developed in the PRAER are summarized in this work plan.

As shown in the three-dimensional CSM (Figure 9), the four site investigation units are:

1. non-operating areas

2. operating areas
3. sludge and waste areas
4. ecological areas

5.4.1 Non-operating Areas

Non-operating areas, based on the site history, are designated as:

1. Unused areas 1 and 2
2. Office area
3. Laydown area
4. Cemetery area, and
5. Borrow area.

A decanning operation was proposed by MSC for the northern portion of Unused Area 2 and a landfill for Unused Area 1. Site records do not indicate that either the decanning operation or landfill were authorized by the state or constructed by MSC. The Laydown and Cemetery Areas contain excess tanks and concrete rubble; however, there is no evidence of waste disposal or storage in these areas.

The critical decision for these areas is “Have there been releases to surface soils?” The decision statement for the Non-operating Areas was developed in the DQO process as:

“Determine whether COC concentrations in on-site surface soils in non-operating units exceed site-specific risk-based human health or ecological criteria and warrant additional investigations or a response action, or whether the COC concentrations are equal to or less than site-specific risk-based human health or ecological criteria and the on-site surface soils in operating units require No Further Action.”

If there have been releases to surface soils exceeding site-specific human health or ecological screening levels, then the project team will decide if additional samples to delineate the horizontal and/or vertical extent of impacted soils are warranted. Limited additional sampling may be implemented to obtain a volume estimate if the impacted area will be subject to an appropriate remedial alternative. In contrast, more extensive surface or subsurface sampling may be implemented to obtain data for the risk assessments The sampling strategy for this investigation unit uses surface soil (0 – 0.5 feet) to evaluate human health risk for recreational users and industrial workers as well as ecological risk and shallow soil borings (0-2 feet) for construction workers. Samples will be analyzed on-site for either total petroleum hydrocarbons (TPH) or PAHs using immunoassay and/or ultraviolet fluorescence (UVF) technologies. Depending on the screening results, surface and possibly subsurface samples (if field screening indicates higher concentrations than surface samples) will be analyzed for parameters indicated in the FSP. The SAP describes the specific activities for obtaining this data, including proposed sample locations in the FSP and data quality requirements in the QAPP.

Borrow Pit shallow soil samples will serve two purposes: to provide chemical data for the suitability of this area as cap material and to provide background metals data. In addition, deeper borings (approximately 20 feet) will be installed in the Borrow Pit to obtain geotechnical samples to support the evaluation of the preliminary remedial alternatives, i.e. the potential use of the soils in this area as borrow for capping or related activities.

5.4.2 Operating Areas

The site operating areas include tanks and other structures that handled or stored waste and other materials. As shown in Figure 9, the three-dimensional site conceptual model, the operating areas include:

1. the laboratory area,
2. the WDW-138 deep well area,
3. the maintenance area (including the 300 through 700 units and the 900 unit), and
4. the 800 Tank area.

The two critical decisions for these areas are “Has there been releases to surface soils?” and “Has there been releases to subsurface soils?” Subsurface soils are of concern in areas with sumps or historical pits. Surface soil data are not adequate in these areas to identify the presence of impacted soils since releases may have occurred at depths greater than the proposed two-foot sample interval for surface soils. The decision statements for the Operating Areas were developed in the DQO process as:

“Determine whether COC concentrations in on-site surface soils in operating units exceed site-specific risk-based human health and ecological criteria and warrant a response action, or whether the COC concentrations are equal to or less than site-specific risk-based human health criteria and the on-site surface soils in operating units require No Further Action.”

“Determine whether COC concentrations in on-site subsurface soils in operating units exceed site-specific human health screening levels and warrant a response action, or whether the COC concentrations are equal to or less than site-specific risk-based human health criteria and the on-site subsurface in operating units require No Further Action. “

If there have been releases to surface soils exceeding site-specific human health screening levels, then the project team will decide if additional surface or subsurface samples are required to delineate the horizontal and vertical extent of impacted soils. If there have been releases to subsurface soils in the sump and historical pit areas, then the project team will decide if additional subsurface samples to delineate the horizontal and vertical extent of impacted soils is warranted. Limited additional sampling may be implemented to obtain a volume estimate if the impacted area will be subject to an appropriate preliminary remedial alternative, as discussed in Section 4 of this RI/FS Work Plan. In contrast, more extensive sampling may be implemented to obtain data for the risk assessment if the impacted area may not be part of a remedial alternative.

The sampling strategy for this investigation unit uses both surface soils (0-0.5 feet) and shallow soil borings (1-2 feet) to collect samples to evaluate human health risk. Samples will be analyzed on-site for either TPH or PAHs using immunoassay technologies. The SAP describes the specific activities for obtaining this data, including proposed sample locations in the FSP and data quality requirements in the QAPP. In addition, deeper borings (approximately 20 feet) will be installed in the areas adjacent to sumps and in the historical pit areas to obtain chemical samples to identify impacted deeper soils. If necessary, based on the initial data, additional borings may be installed for vertical or horizontal delineation of impacted soils.

5.4.3 Sludge and Waste Areas

Sludge and waste are contained in the both the Sludge and Oil Pits in the Earthen Impoundment. In addition, sludge and waste are also contained in the API Separators. The critical decision for this material is “Can the sludge and waste be treated using the preliminary remedial alternatives?” The decision statement for the Sludge and Waste Areas was developed in the DQO process as:

“Determine whether physical and chemical characteristics of sludge, waste materials, and heavily contaminated soil support the preliminary remedial alternative or whether the physical and chemical concentrations require the selection of other preliminary remedial alternatives.”

Limited chemical characterization of sludge and waste materials is planned as part of the RI. The PSCR concluded that existing data is adequate to define the chemical content and it is unlikely, due to the nature of materials, lower reporting limits would be obtained. Physical characterization of sludge and waste materials before and after treatment is described in the Treatability Study Work Plan (Appendix G).

The sampling strategy for this investigation unit uses various techniques to collect representative samples for the treatability studies. The SAP describes the specific activities for obtaining this data, including proposed sample locations in the FSP and data quality requirements in the QAPP.

5.4.4 Ecological Areas

Ecological areas are those portions of the site that appear to provide a suitable habitat for ecological receptors. These areas include the Freshwater Pond and surrounding land, the site drainage ditches, and the marshy area between the hurricane levee and Swan Lake. The critical decision for these areas is “Has there been a release from MSC that can impact ecological or human receptors?” Two decision statements for this investigation unit have been derived:

"Determine whether COC concentrations in on-site surface water exceed site-specific risk-based human health or ecological criteria and warrant additional investigation or a response action, or whether the COC concentrations are equal to or less than site-specific risk-based human health or ecological criteria and the surface water require No Further Action."

"Determine whether COC concentrations in on-site and off-site sediments exceed site-specific risk-based human health or ecological criteria and warrant additional investigations or a response action, or whether the COC concentrations are equal to or less than site-specific risk-based human health or ecological criteria and the sediments require No Further Action."

If there have been releases to sediments exceeding human or site-specific ecological screening levels, then the project team will decide if additional samples to delineate the horizontal and/or vertical extent of impacted sediments is warranted. Limited additional sampling may be implemented to obtain a volume estimate if the impacted area will be subject to an appropriate remedial alternative.

The SAP describes the specific activities for obtaining sediment and surface water data, including proposed sample locations in the FSP and data quality requirements in the QAPP. Since many of the COCs are projected to have low risk-based screening numbers and high quality data is needed for the screening-level ecological risk assessment (SLERA), on-site analyses are not planned. The methods for conducting the SLERA, including the screening benchmarks are presented in Appendix F.

6.0 RI/FS TASKS

This section of the RI/FS Work Plan describes the tasks that will be performed during the RI/FS. USEPA has identified 14 standard tasks for consistent reporting and effective monitoring of the RI/FS process (USEPA 1988). Each of the following tasks are discussed below:

- Task 1 – Project Planning
- Task 2 – Community Relations
- Task 3 – Field Investigation
- Task 4 – Sample Analysis/Validation
- Task 5 – Data Evaluation
- Task 6 – Assessment of Risks
- Task 7 – Treatability Study/Pilot Testing
- Task 8 – Remedial Investigation Reports
- Task 9 – Remedial Alternatives Development/Screening
- Task 10 – Detailed Analysis of Remedial Alternatives
- Task 11 – Feasibility Study Report
- Task 12 – Post RI/FS Support
- Task 13 - Enforcement Support
- Task 14 – Miscellaneous Support

The Order includes requirements for activities through Task 11; therefore, this RI/FS Work Plan and associated work plans discuss how MCP will meet the requirements of the Order and the RI/FS Guidance.

6.1 Task 1 - Project Planning

The project planning task includes the efforts related to initiating an RI/FS. This task began with the Project Kickoff meeting and will be complete when the work plans are approved by USEPA. Elements included in this task are:

1. kickoff meetings
2. site visits and reconnaissance
3. collection and evaluation of existing data
4. development of the CSM
5. identification of data needs and DQOs

6. identification of preliminary remedial action objectives and potential remedial alternatives

7. preliminary identification of ARARs

8. identification of treatability studies

9. preparation of plans (RI/FS Work Plan, HASP, QAPP, FSP, and treatability study work plans)

10. task management and quality control

Each of the elements is discussed in detail below. If an element was completed prior to the preparation of this RI/FS Work Plan, then the deliverable and date of delivery are provided.

6.1.1 Kickoff Meetings

A project kickoff meeting with representatives of the MCP, USEPA and URS Corporation (URS) was conducted in January 2004. A RI/FS planning meeting with representatives of the MCP, USEPA and URS was conducted in September 2004.

In order to effectively manage the RI/FS, monthly teleconferences are held with representatives of the MCP, USEPA and URS. The specific agenda for each teleconference varies, but the following items are discussed:

completed tasks

future tasks

schedule

quality control

6.1.2 Site Visits and Reconnaissance

Representatives of the MCP and URS have conducted site visits during the spring and summer 2004. Each of the key participants in the project, as identified in the organization chart, have visited the site to observe, as needed, physical features, operating units, and access. Site visits were conducted to

introduce the site to members of the MCP;

locate and identify monitoring wells;

locate and identify stormwater sample points;

acquaint the human health and ecological risk assessors with the site setting, operating units and other information needed to prepare human health and ecological risk assessment work plans; and

familiarize the URS health and safety officer with the site prior to preparation of the HASP.

Site visits and reconnaissance are planned prior to implementing each major step of the RI/FS. The goal of each these visits will be to familiarize the participants with the site, locate and identify the areas for sampling, identify access and review site-specific health and safety issues.

6.1.3 Collection and Evaluation of Existing Data

The MCP were to provide USEPA with a PSCR as the first deliverable in the Order. The objectives of the PSCR were to:

- collect and analyze existing data;
- develop a CSM;
- develop a list of potential state and federal ARARs and to-be-considered (TBC) advisories, criteria or guidance; and
- identify data needs.

The PSCR was developed as the result of an effort to locate data from relevant sources, including files maintained at the USEPA Region 6 headquarters in Dallas, Texas, and the TCEQ files in Austin, Texas, the GCWDA, the MOTCO Superfund Site, and the Tex-Tin Superfund Site. Information contained within the USEPA and TCEQ files included primarily reports prepared by MSC or the agencies, work plans, and documents directly related to the MSC site operations and environmental studies.

The final PSCR report was delivered to USEPA in April 2004 (URS 2004a). The key findings in the PSCR are summarized in Section 2.0 (Site Background and Setting).

6.1.4 Develop a Conceptual Site Model

A CSM, based on the data compiled and presented in the PSCR, was discussed in the PSCR and refined in the PRAER (URS 2004a, URS 2004b). The CSM is discussed in Section 3.0 (Conceptual Site Model). As further data is gathered during the RI/FS, the CSM will be updated and refined. The final site CSM will be discussed in the RI/FS report.

6.1.5 Identification of Data Needs and DQOs

Both the PSCR and PRAER identified data gaps and presented information needed to complete the RI/FS. DQOs, which state the necessary level of data quality, are developed for each RI/FS activity. DQOs are discussed in the QAPP. A DQO planning meeting with representatives of the MCP, USEPA and URS was conducted in September 2004.

6.1.6 Identification of Preliminary Remedial Action Objectives and Potential Remedial Alternatives

The MCP provided USEPA with the second deliverable in the Order, the PRAER, in July 2004 (URS 2004b). The objectives of the PRAER were to:

- develop remedial action objectives;
- develop a list of potential state and federal ARARs and TBC advisories, criteria or guidance;
- develop and screen alternatives evaluated at similar waste sites;
- determine preliminary remedial alternatives;
- identify candidate treatability studies; and
- develop conceptual treatability study plans.

The preliminary remedial alternatives were selected using data and experience from the MSC Superfund Site and from other Superfund or related waste sites with similar settings, histories, and contaminants to eliminate inappropriate remedial alternatives and focus on the remedies most likely to be appropriate to the MSC Superfund Site.

The final PRAER report was delivered to USEPA in July 2004. The key findings in the PRAER are summarized in Section 4.0 (Preliminary Remedial Alternatives).

6.1.7 Preliminary Identification of ARARs

The potential state and federal action-specific, chemical-specific, and location-specific ARARs that may be applicable to the RI and remedial action for the MSC Superfund Site were identified in the PSCR and PRAER. Tables 3 through 5 list the preliminary ARARs and TBCs for the site. These ARARs and TBCs were previously presented in the PSCR and refined and updated in the PRAER (URS 2004a, URS 2004b).

Section 121(d)(2)(A) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), incorporates into the law the CERCLA compliance policy. This policy specifies that Superfund remedial actions meet any Federal standards, requirements, criteria, or limitations that are determined to be legally ARARs. Also included is a provision requiring that State ARARs be met if they are more stringent than Federal requirements but only to the point where state ARARs are consistently enforced. The purpose of this requirement is to make CERCLA response actions consistent with other pertinent Federal and State environmental requirements. This section identifies the potential state and federal action-specific, chemical-specific, and location-specific ARARs that may be applicable to the RI and remedial action for the MSC Superfund Site. In addition, this section discusses the TBC advisories, criteria, and guidelines.

6.1.8 Action-Specific ARARs

Action-specific ARARs are usually technology or activity-based requirements or limitations on action taken with respect to hazardous waste. These ARARs may set controls or restrictions on the particular treatment and disposal activities implemented at the MSC Superfund Site. These requirements are triggered by the particular remedial activities that are selected to accomplish a remedy. Action-specific ARARs are generally not finalized until the development of alternatives in the FS. The action-specific ARARs listed in this document are generic and will be refined as the steps in the FS process are completed. Table 3 summarizes the preliminary ARARs for the preliminary remedial alternatives discussed in this document.

6.1.9 Chemical-Specific ARARS

Chemical-specific ARARs are usually human health or ecological risk-based numerical values. The values may define acceptable exposure levels and may serve as the basis for establishing preliminary remediation goals. The values are derived from published tables or by methodologies, which applied to site-specific conditions, result in the establishment of numerical values. If a chemical has more than one ARAR requirement, the more stringent requirement applies. A description of the potential COCs and the affected media are required to finalize the chemical-specific ARARs. Table 4 summarizes the preliminary ARARs for the chemicals detected at the MSC Superfund Site. If the COC list is refined based on the RI results, the chemical-specific ARARs may change with COC removals and additions.

6.1.10 Location-Specific ARARS

Location-specific ARARs are restrictions placed on the concentration of hazardous substances or the implementation of activities based solely on specific locations. Examples of specific locations that may require the development of ARARs, include floodplains, wetlands, historic places, cemeteries, and sensitive ecosystems or habitats. Location-specific ARARs are refined after the site's physical features are identified and finalized after the evaluation of the remedial technologies. Table 5 summarizes the location-specific ARARs for the MSC Superfund Site.

6.1.11 Identification of Treatability Studies

The Presumptive Remedy section of the PRAER identified data gaps and candidate treatability studies. This information is summarized in Section 4.0 (Preliminary Remedial Alternatives).

6.1.12 Preparation of Plans

The Order requires that the following plans be prepared prior to initiating RI/FS field activities:

RI/FS Work Plan,

FSP,

QAPP,

HASP,

Human Health Risk Assessment Work Plan,

Ecological Risk Assessment Work Plan, and

Treatability Study Work Plan.

Table 1 summarizes the AOC requirements and the section of the RI/FS Work Plan where each deliverable can be found. Since the RI/FS Work Plan documents decisions and evaluations from the scoping process as well as presents future tasks, it serves as the link between each of the other work plans. These work plans, other than the HASP, are presented as appendices to the RI/FS Work Plan. To emphasize health and safety, and for ease of use in the field activities, the HASP was prepared as a separate document.

The SAP follows the format described in Table 2-4 (Suggested Format for SAP (FSP and QAPP)) of the RI/FS Guidance (USEPA 1988). The SAP includes the FSP and the QAPP (Appendix A and B, respectively).

The FSP defines in detail the sampling and data-gathering methods for characterizing the site. The site has been divided into investigation units based on operating history and preliminary remedial alternatives. The investigation units for the site are divided into sediments, surface water, surface and subsurface soils, groundwater, and sludge. The FSP contained in Appendix A includes sampling objectives, sample location and frequency, sampling equipment and procedures, and sample handling and analysis for each investigation unit.

As required by the Order, the QAPP describes the project objectives and organization, functional activities, and QA/QC protocols that are planned to meet the desired DQOs. The QAPP also addresses sampling procedures, sample custody, analytical procedures, and data reduction, validation, reporting and personnel qualifications. The QAPP is contained in Appendix B.

6.1.13 Task Management and Quality Control

Task management is discussed in detail in the following sections of the RI/FS Work Plan. Quality control is discussed in detail in the QAPP contained in Appendix B.

6.2 Task 2 - Community Relations

This task includes the efforts related to the preparation and implementation of the community relations plan. The activities in this task are described in the community relations plan contained in Appendix C. The components of the community relations plan include a description of the following activities:

interviewing interested parties;

establishing and maintaining a site mailing list;

establishing and updating the public repository for site documents;

providing technical support for community relations activities;

providing public meetings to comment on the RI/FS report and proposed remedial actions; and

summarizing public comments on the RI/FS report and proposed remedial actions with the USEPA's responses to the comments.

Section II (Community Relations) of Exhibit A for the AOC reserves the responsibility for developing and implementing of community relations activities to the USEPA. However, if requested by USEPA, the MCP will provide technical support for community relations activities. This task will be complete when Task 12 (Post RI/FS Support) is complete.

This Order also delegates to the MCP the responsibility of establishing the community information repository. The MCP have established a community information repository at the Moore Memorial Public Library, located in Texas City, Texas.

6.3 Task 3 - Field Investigations

This task involves efforts related to the RI/FS field investigations. The following activities are included in this task:

planning field investigations

preparing the FSP

procuring sub-contractors

mobilization

geological/hydrogeological investigations

sampling for chemical characterization and treatability studies

waste disposal

These activities are described in the FSP contained in Appendix A. This task began with the planning of the RI/FS and will be complete when contractors demobilize permanently from the site.

6.4 Task 4 - Sample Analysis/Validation

This task includes the field and laboratory analyses of samples as well as the validation of the data. Included in this task are:

planning analytical requirements

procurement of field and laboratory analytical services

sample management

chemical analyses

physical characterization

data validation

This task began with the preparation of the QAPP and ends when data validation is complete. The QAPP is contained in Appendix B.

6.5 Task 5 - Data Evaluation

Data evaluation is related to the interpretation of the data once they have been verified to meet the method quality objectives specified in the QAPP. This task begins when the first set of validated data is received by the project team and ends when the project team deems that no additional data are required. The following activities are associated with the data evaluation task:

data evaluation by the chemists, engineers, geologists, hydrogeologists, and risk assessors

data reduction and tabulation

environmental fate and transport modeling/evaluation

Data evaluation requirements are presented in the QAPP, and the Human Health and Ecological Risk Assessment Work Plans contained in Appendices E and F, respectively. The management of the data is described in the Data Management Plan contained in Appendix D.

6.6 Task 6 - Risk Assessment

This task includes the assessment of human health and ecological risks associated with the site. This task began with the planning of the RI and the development of the CSM. This task will be completed with the acceptance of the Baseline Human Health Risk Assessment (BLHHRA) and the Screening Level Ecological Risk Assessment (SLERA) or the Baseline Ecological Risk Assessment (BERA) by the USEPA. The following activities will be conducted in the risk assessment task:

identification of COCs

exposure assessment (including modeling)

toxicity assessment

risk characterization

uncertainty analyses

These activities are described in the Human Health Risk Assessment Work Plan and the Ecological Risk Assessment Work Plan contained in Appendices E and F, respectively. Only the Screening Level Ecological Risk Assessment (SLERA) Work Plan is include in this RI/FS Work Plan submittal. If indicated by the SLERA, a Baseline Ecological Risk Assessment Problem Formulation Report will be submitted to the EPA for review and approval followed by a BERA

Work Plan. These last two potential deliverables are not included in the current RI/FS Work Plan since they are dependent on the outcome of the SLERA.

6.7 Task 7 - Treatability Study/Pilot Testing

This task includes the preparing work plans and conducting pilot, bench, and treatability studies. The task began with the preparation of the PRAER and will be complete upon USEPA's acceptance of the FS report. The following activities are included in this task:

- work plan preparation
- subcontractor procurement
- vendor and analytical service procurement
- equipment operation and testing
- sampling analysis and validation
- evaluation of results

The treatability study work plan for the solidification of oily sludge is included in Appendix G.

6.8 Task 8 - Remedial Investigation Report

This task includes those activities required to prepare and present the RI findings. The RI Report is submitted to USEPA after completion of Tasks 3 through 6 (Field Investigation through Assessment of Risks). This task began with the preparation of the PSCR and ends when the RI Report is accepted by USEPA. Activities planned for this task include:

- preparation of the PSCR (completed April 2004)
- data presentation (tables and figures)
- report writing
- printing and distributing the report to MCP
- revising the report based on the comments from the MCP
- printing and distributing the report to USEPA and TCEQ
- revising the report based on USEPA comments

The RI Report will generally follow the format presented in Table 3-13 of the RI/FS guidance (USEPA 1988) and meet the requirements of Attachment 3 to the Statement of Work for Remedial Investigation (RI) and Feasibility Study (FS) for the MSC Superfund Site.

6.9 Task 9 – Remedial Alternatives Development / Screening

This task includes efforts to select the alternatives to undergo full evaluation. The task is initiated once sufficient data are available from the treatability studies to develop the general response actions and to begin the evaluation of technologies. This task is complete when the final set of remedial alternatives is chosen for detailed evaluation. The following activities are included in this task and will be prepared in consideration of the results presented in the PRAER:

- identifying/screening potential technologies
- assembling potential alternatives
- evaluating each alternative on the basis of the three screening criteria (effectiveness, implementability, and cost)
- quality control review of work effort
- preparing the technical memorandum
- refining the list of alternatives for detailed analysis

The results of this task will be included in the FS Report.

6.10 Task 10 - Detailed Analysis of Remedial Alternatives

This task will focus on the detailed analysis and comparison of alternatives based on the first seven of the nine evaluation criteria listed below:

- overall protection of human health and the environment
- compliance with ARARs
- long-term effectiveness and permanence
- reduction of toxicity, mobility, or volume
- short-term effectiveness
- implementability
- cost
- state acceptance
- community acceptance

State and community acceptance will be evaluated by USEPA during remedy selection.

This task begins when the development/screening of remedial alternatives is completed and the task ends when the analysis is complete. The following activities will be performed in this task:

- refinement of alternatives
- individual analysis against the criteria

comparative analysis of alternatives against the criteria

QC review of analyses

The results of this task will be included in the FS Report.

6.11 Task 11 - Feasibility Study Report

This task is to prepare and report the FS. Activities planned for this task include:

data presentation (tables and figures)

report writing

printing and distributing the report to MCP

revising the report based on the comments from the MCP

printing and distributing the report to USEPA and TCEQ

revising the report based on USEPA comments

6.12 Task 12 – Post RI/FS Support

As described in the RI/FS Guidance (USEPA 1988), this task begins after release of the FS to the public and continues until the ROD is approved and released by USEPA. This task is the responsibility of the USEPA. Activities that may be conducted by USEPA in this task include:

- preparing the predesign report
- preparing the conceptual design
- attending public meetings
- writing and reviewing the responsiveness summary
- supporting ROD preparation and briefings
- quality control and review of the work effort

6.13 Task 13 - Enforcement Support

This task began with the initial listing of the site on the NPL and will continue throughout the RI/FS. This task is the responsibility of the USEPA. Typical activities, as identified in the RI/FS Guidance (USEPA 1988), include:

- reviewing PRP documents
- attending negotiation meetings
- preparing briefing materials
- assisting in the preparation of the ROD

6.14 Task 14 – Miscellaneous Support

Miscellaneous support includes those activities associated with the project, but that are outside the normal RI/FS scope of work. These activities may be the responsibility of USEPA or the MCP. For the MSC Superfund Site, the following potential miscellaneous support activities have been identified:

- stormwater management,
- disposal of laboratory waste, and
- decommissioning of tanks and related structures.

The MCP at the request of USEPA has implemented several tasks for stormwater management. The 2004 mechanical integrity test and bottom hole pressure survey of WDW-138 was performed in March 2004. A report summarizing the finding was submitted to the USEPA and TCEQ in April 2004 (Sandia 2004). The following deliverables were prepared and presented to USEPA and TCEQ for review:

- Stormwater Management Plan, July 2004 (URS 2004c)
- Operations and Management Plan, July 2004 (URS 2004d)
- Stormwater Sampling and Analysis Plan and Quality Assurance Management Plan, July 2004 (URS 2004e)
- Stormwater Health and Safety Plan, July 2004 (URS 2004f)

Other support activities may be implemented as negotiated by the MCP and USEPA.

7.0 SCHEDULE

The anticipated schedule for the RI/FS is presented in Figure 10. The schedule identifies key activities, a detailed field sampling schedule, and deliverable dates.

8.0 PROJECT MANAGEMENT

This section constitutes the Project Management Plan for the MSC RI/FS. The Project Management Plan describes the project organization and staff, work plan coordination, and project communications.

8.1 Project Organization

An organization chart for the project is shown in Figure 11. The primary decision-makers for implementing the Triad approach and the RI/FS Work Plan are shaded in yellow on the organization chart. Responsibilities for the project organization are summarized below.

The **MCP Technical Committee Chair** is responsible for presiding over Technical Committee meetings and providing Technical Committee recommendations to the full MCP membership.

The **USEPA Remedial Project Manager (RPM)** is the primary point of contact within the USEPA for all site related issues. The USEPA RPM is responsible for the overall direction of the project in accordance with the provisions of CERCLA, SARA, the RI/FS Work Plan, the SAP and ensuring that the work progresses according to the priorities and objectives established during the planning process. The USEPA RPM will consolidate comments on work plans and reports from USEPA personnel and other parties for responses to the MCP.

The **Project Coordinator** communicates and coordinates activities with USEPA, URS and the MCP. The Project Coordinator is responsible for the overall coordination of PRP input to USEPA and URS. The Project Coordinator tracks schedules and deliverables as defined by the Order and RI/FS Work Plan.

The **Project Director** serves as the principal-in-charge for the project. The Project Director provides senior review of project deliverables as needed, consults and advises on project strategy.

The **USEPA Quality Assurance Officer (QAO)** serves the USEPA RPM as a resource on analytical chemistry and QA/QC. The responsibilities of the USEPA QAO include review of the QAPP and associated FSP, technical assistance in the resolution of QA/QC or analytical chemistry issues, and review of data packages and Data Usability Summaries. The USEPA QAO will also provide technical assistance to the USEPA RPM on the implementation of the Triad approach.

The **URS Project Manager** (**Technical Project Manager**) will manage URS' personnel involved in the project and will be responsible for URS cost and schedule tracking. Specific responsibilities of the URS Project Manager include ensuring that data submitted to the USEPA are collected, analyzed, evaluated, and documented according to the requirements of this QAPP, communicating and coordinating with the USEPA and MCP Technical Committee Chair, and reviewing and approving field activities and reports. The URS Project Manager will also provide technical review of project deliverables.

The **Project Geologist** is one of the primary data users for the project. The **Project Geologist** provides geological and hydrogeological expertise and knowledge of federal Superfund requirements. The Project Geologist will be responsible for the preparation of the geology and hydrogeology sections of the RI/FS Report.

The **Field Investigation Manager** will implement the SAP and provide technical support to the field sampling team. The Field Investigation Manager is responsible for implementing the requirements of the HASP. The Field Investigation Manager will oversee sample collection and supervise all work in accordance with the FSP. The Field Investigation Manager will be responsible for organizing and coordinating the activities of the drilling subcontractor(s), the field crew, and activities associated with sampling activities. The Field Investigation Manager will update the Technical Project Manager on project progress. The Field Investigation Manager will arrange for permits, utility clearances, and surveying. The Field Investigation Manager will procure facilities, equipment, and supplies necessary to perform field operations. The Field Investigation Manager will prepare the RI Field Activities section of the RI/FS report.

The **Project QAO** will prepare the QAPP and review the associated FSP and provide technical assistance in the resolution of QA/QC or analytical chemistry issues. The Project QAO will also provide technical assistance to the project personnel and the MCP on the implementation of the Triad approach. Other responsibilities include an evaluation of sampling procedures, laboratory analyses, and project documentation with respect to QAPP requirements. The Project QAO will procure field and laboratory analytical services and coordinate these analytical services. The Project QAO will prepare the Data Usability Summaries and the chemical summary sections of the RI/FS report.

The **Human Health and Ecological Risk Assessors** are also primary data users for the project. The URS Human Health and Ecological Risk Assessors will prepare the risk assessment work plans, provide input into the flexible work plan decisions, interpret the field and laboratory data and prepare the risk assessments. The USEPA counterparts will review and approve the risk assessment work plans, as well as participate in the flexible work plan decisions. USEPA Human Health and Ecological Risk Assessors will review and approve the Baseline Risk Assessment Report and the Screening Level Ecological Risk Assessment reports, respectively.

Other parties are also part of the project organization. The **TCEQ Superfund Group** has authority to review and comment on work plans and reports to ensure that the RI/FS activities are in conformance with State of Texas requirements. The legal responsibility for restoring natural resources injured by hazardous substances belongs to **Federal, State, and Tribal Trustees** for fish, wildlife, other living resources, water, lands, and protected areas. The process by which the Trustees evaluate injuries associated with hazardous substance contamination in natural resources is known as a natural resource damage assessment (NRDA). Data generated during the RI will be incorporated into the Trustee Preassessment Screen Determination document. These parties can provide comments to USEPA on the RI/FS Work Plan and the RI/FS Report.

8.2 Project Management

In order to effectively implement the flexible work plan and to optimize field activities, project team decision makers have been designated in the project organization. Significant changes to the SAP will not be made without the consensus of the project team decision makers. As shown on Figure 11, the project team decision makers are the:

- MCP Technical Committee Chair,
- USEPA Remedial Project Manager,
- Project Coordinator,
- URS Project Manager,
- URS Project QA/QC Officer, and
- USEPA QA Officer.

The Project Coordinator, the USEPA Remedial Project Manager, and the URS Project Manager have decision level authority for implementing changes to the SAP. Policy decisions are communicated for the PRPs by the Project Coordinator and are communicated for USEPA by the USEPA Remedial Project Manager. The URS Project Manager is responsible for implementing the policy decisions.

The Technical Expertise Team Members support the project team decision-makers. These include the:

USEPA Ecological Risk Assessor,

USEPA Human Health Risk Assessor,

URS Ecological Risk Assessor,

URS Human Health Risk Assessor,

URS Project Geologist,

URS Field Investigation Manager, and

URS Project Director.

When appropriate, the Technical Expertise Team Members will be consulted and will provide advice on changes to the SAP that may affect the areas for which they have responsibility.

8.3 Project Communications

The URS Project Manager will provide the MCP Technical Committee Chair, the Project Coordinator, and the USEPA Remedial Project Manager with Field Change Orders as data become available and the FSP is modified. The Project Coordinator will provide USEPA with monthly progress reports.

8.3.1 Field Change Orders

Field change orders will be submitted to USEPA if significant changes to the FSP are planned. The field change order will summarize:

- the field or analytical data that indicates that the sampling and/or analytical activities should be modified,
- the DQO question that the modified sampling or analytical activity supports,
- rationale for the change, and
- the modification to the FSP.

Field change orders will be initiated by the appropriate personnel and transmitted by the URS Project Manager via electronic mail to the MCP Technical Committee Chair, the Project Coordinator, and the USEPA Remedial Project Manager. In addition, field change orders will be discussed in the monthly teleconferences.

8.3.2 Technical Exchange Meetings

Additional meetings will be scheduled during the execution of the RI to resolve data collection/interpretation modifications to the SAP. These meetings will be scheduled as issues arise that required a consensus of the team. The URS Project Manager, the MCP Technical Committee Chair, the Project Coordinator, or the USEPA Remedial Project Manager can request these Technical Exchange Meetings. The URS Project Manager, the Project Coordinator, and the USEPA Remedial Project Manager will participate in the Technical Exchange Meetings and the participation of other project personnel may be requested.

8.3.3 Monthly Progress Reports

Monthly progress reports will be submitted to USEPA by the tenth day of each month. The monthly report will include the brief description of the following subjects:

1. technical Summary of Work
2. schedule
3. problems

The Technical Summary will describe the activities and decisions for the month under report and activities scheduled for the upcoming reporting period. In addition, technical data (analytical results) will be appended to the Monthly Progress Report. The Monthly Progress Report will also include a comparison of activities completed to the activities planned on the project schedule. Problems encountered that could affect the RI/FS will also be discussed in the Monthly Progress Reports. Examples of problems that may be discussed include delays in mobilization, access issues, laboratory analytical turnaround times, unsatisfactory QA/QC performance, weather conditions, unanticipated site conditions, and requirements for additional or more complex sampling, including Field Change Orders. Monthly progress reports are transmitted electronically to the USEPA Remedial Project Manager, the MCP Technical Committee and the URS Project Manager.

8.4 Recordkeeping

Recordkeeping requirements are described in the Data Management Plan (Appendix D). Records, documents and other information pertaining to the MSC Superfund Site as well as documentation used to prepare the required deliverables, will be maintained for a minimum of six years after the complete of the work and the termination of the Order. The MCP will maintain records pertaining to project administrative activities, technical analysis, analytical data, and decision-making. Administrative documents include work plans, contracts, change orders, key personnel changes, and communications between MCP, the TCEQ and EPA regarding technical aspects of the RI/FS. Technical analysis documents, including field log books, labels, shipping and chain-of-custody forms, as well as analytical data will be handled and maintained as described in the QAPP. Decision making documents include minutes of meeting between MCP members and/or URS that involve decisions affecting technical aspects of the RI/FS.

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TABLES

Table 1 AOC Requirements

AOC Section	List of Deliverables	Requirement	Work plan Section
I.1 / I.3.e	VII.1	Site Health and Safety Plan	Separate Deliverable
I.3.a	VII.3	Preliminary Site Characterization Report	April 2004
1.3.b	VII.5	Preliminary Remedial Alternatives Evaluation Report	July 2004
I.3.c / I.14. – I.17.	VII.6	RI/FS Work Plan	This deliverable
1.3.d / I.13	VII.7	Sampling and Analysis Plan – FSP	Appendix A
1.3.d	VII.7	Sampling and Analysis Plan – QAPP	Appendix B
I. 6	VII.2	Scoping Planning Meeting	January 2004
I.16.		Quality Management Plan	November 2003
	Attachment 2.A	Project Management Plan	Section 7
I.16	Attachment 2.B	Data Management Plan	Appendix G
II.19		Community Relations Plan	Appendix F
V.29.B.		Treatability Studies Work Plan	Appendix E

Table 2 Maximum Source, Soil, Sediment, and Groundwater Concentrations

Parameter	Source (mg/Kg)	Soil (mg/Kg)	Sediment (mg/Kg)	Groundwater (mg/L)
Acetone	1130	6	0.026	2190
Benzene	1900	0.3	0.003	48.2
Bromodichloromethane	< 200	< 0.3	< 0.023	< 10
Bromoform	< 200	< 0.3	< 0.023	< 10
Bromomethane	< 200	< 0.6	< 0.023	< 10
Butanone, 2- (MEK)	1240	3	0.008	84.7
Carbon disulfide	< 178	< 0.015	0.023	14.1
Carbon tetrachloride	202	< 0.3	< 0.023	31.7
Chlorobenzene	440	< 0.3	< 0.023	1.81
Chloroethane	< 200	< 0.6	< 0.023	0.058
Chloroform	200	< 0.3	< 0.023	4.99
Chloromethane	< 200	< 0.6	< 0.023	< 10
Cumene	700	NA	NA	NA
Dibromo-3-chloropropane, 1,2-	NA	NA	NA	< 0.1
Dibromochloromethane	1420	< 0.3	< 0.023	< 10
Dibromoethane, 1,2-	NA	NA	NA	< 0.1
Dichloro-2-butene, trans-1,4-	750	NA	NA	< 1
Dichlorodifluoromethane	NA	NA	NA	< 0.25
Dichloroethane, 1,1-	190	< 0.3	< 0.023	10.8
Dichloroethane, 1,2-	3740	< 0.3	< 0.023	483
Dichloroethene, 1,1-	281	1	< 0.023	5.2
Dichloroethene (Total),1 ,2-	< 178	< 0.015	< 0.023	5.8
Dichloroethene, cis-1,2-	< 178	NA	NA	1.8
Dichloroethene, trans-1,2-	< 200	< 0.3	NA	0.37
Dichloropropane, 1,2-	< 200	< 0.3	< 0.023	< 10
Dichloropropene, cis-1,3-	< 200	< 0.3	< 0.023	< 10
Dichloropropene, trans-1,3-	< 200	< 0.3	< 0.023	< 10

Table 2 Maximum Source, Soil, Sediment, and Groundwater Concentrations

Parameter	Source (mg/Kg)	Soil (mg/Kg)	Sediment (mg/Kg)	Groundwater (mg/L)
Ethylbenzene	4900	6	0.007	35.1
Hexanone, 2-	27.6	NA	NA	14.9
Methylene chloride	4700	5	0.015	38.6
Methyl-2-pentanone, 4- (MIBK)	1500	NA	NA	61.2
Styrene	4980	2	< 0.023	8.27
Tetrachloroethene	11,000	0.003	< 0.023	54.3
Tetrachloroethane, 1,1,1,2	NA	NA	NA	9.62
Tetrachloroethane, 1,1,2,2-	658	< 0.3	< 0.023	14.2
Toluene	9900	46	0.019	21.5
Trichloroethane, 1,1,1-	39,000	157	< 0.023	7.22
Trichloroethane, 1,1,2-	2730	< 0.3	< 0.023	84
Trichloroethene	7300	1400	< 0.023	23.6
Trichlorotrifluoroethane	2043	0.2	NA	NA
Vinyl chloride	< 200	< 0.6	< 0.023	2663
Xylenes, total	42,000	14	0.016	411
PCB (Total)	< 1	< 0.1	0.19	0.00063
Acenaphthene	550	67	0.18	0.001
Acenaphthylene	960	8	0.19	< 2.5
Acetophenone	0.16	NA	NA	2.2
Anthracene	550	41	0.38	< 2.5
Benzidine	7000	< 6	NA	< 1
Benzo(a)anthracene	1150	33	1	< 2.5
Benzo(a)pyrene	58	< 6	0.94	< 2.5
Benzo(b)fluoranthene	66	< 6	0.8	< 2.5
Benzo(ghi)perylene	< 990	< 6	0.36	< 2.5
Benzo(k)fluoranthene	< 990	< 6	0.84	< 2.5
Bis(2-Chloroethoxy)methane	< 990	< 6	< 0.75	< 2.5
Bis(2-chloroethyl)ether	270	< 6	< 0.75	2.0

Table 2 Maximum Source, Soil, Sediment, and Groundwater Concentrations

Parameter	Source (mg/Kg)	Soil (mg/Kg)	Sediment (mg/Kg)	Groundwater (mg/L)
Bis(2-chloroisopropyl)ether	< 990	< 6	< 0.75	1.6
Bis(2-ethylhexyl)phthalate	2900	190	3.1	0.080
Bromophenyl phenyl ether, 4-	< 990	< 6	< 0.75	< 2.5
Butyl benzyl phthalate	344	63	< 0.75	< 2.5
Carbazole	21.2	< 0.49	0.18	< 2.5
Chloro-3-methylphenol, 4-	< 990	< 12	< 0.75	< 2.5
Chloroaniline, 4-	< 990	< 0.49	< 0.75	< 2.5
Chloronaphthalene, 2-	< 990	< 6	0.097	< 2.5
Chlorophenol, 2-	21.8	< 12	< 0.75	0.060
Chlorophenyl phenyl ether, 4-	< 990	< 6	< 0.75	< 2.5
Chrysene	170	< 6	1.1	< 2.5
Cresol, o- (2-methylphenol)	338	< 0.49	< 0.75	2.2
Cresol, m&p- (3&4-methylphenol)	472	< 0.49	< 0.75	5.3
Dibenz(a,h)anthracene	< 990	< 6	0.26	< 2.5
Dibenzofuran	233	< 0.49	0.066	< 2.5
Dichlorobenzene, 1,2-	1400	< 6	< 0.75	<2.5
Dichlorobenzene, 1,3-	53	< 6	1.5	< 2.5
Dichlorobenzene, 1,4-	250	< 6	0.12	< 2.5
Dichlorobenzidine, 3,3'-	600	< 6	< 0.75	< 2.5
Dichlorophenol, 2,4-	1700	< 12	< 0.75	3.5
Di-n-butyl phthalate	290	20	0.033	< 2.5
Di-n-octyl phthalate	380	49	0.04	< 2.5
Diethyl phthalate	244	< 6	0.055	0.003
Dimethylphenol, 2,4-	240	< 12	< 0.75	0.24
Dimethylphthalate	110	< 6	< 0.75	0.25
Dinitrophenol, 2,4-	< 4950	< 24	< 0.75	0.033
Dinitrotoluene, 2,4-	414	< 6	< 0.75	0.042
Dinitrotoluene, 2,6-	150	< 6	< 0.75	0.038

Table 2 Maximum Source, Soil, Sediment, and Groundwater Concentrations

Parameter	Source (mg/Kg)	Soil (mg/Kg)	Sediment (mg/Kg)	Groundwater (mg/L)
Dinitro-2-methylphenol, 4,6-	12,600	< 24	< 1.9	< 6.2
Fluoranthene	580	300	1.4	< 2.5
Fluorene	920	37	0.21	< 2.5
Hexachlorobenzene	1800	< 6	0.48	< 2.5
Hexachloroethane	< 990	< 6	< 0.75	0.020
Hexachlorobutadiene	20,000	3	0.065	< 2.5
Hexachlorocyclopentadiene	< 990	< 6	< 0.75	< 2.5
Isophorone	610	< 6	< 0.75	0.700
Indeno(1,2,3-cd)pyrene	< 990	< 6	0.57	< 2.5
Methylnaphthalene, 2-	12,000	7	0.25	< 2.5
Naphthalene	7630	11	0.14	0.220
Naphthylamine, 1-	220	NA	NA	< 0.01
Nitroaniline, 2-	< 990	< 1.2	< 1.9	< 6.2
Nitroaniline, 3-	< 990	< 1.2	< 1.9	< 6.2
Nitroaniline, 4-	< 990	< 1.2	< 1.9	< 6.2
Nitrobenzene	74	< 6	< 0.75	< 2.5
Nitrophenol, 2-	1.9	< 12	< 0.75	< 2.5
Nitrophenol, 4-	1400	< 24	< 1.9	0.084
Nitrosodi-n-butylamine	370	NA	NA	< 0.5
n-Nitrosodiphenylamine	71.9	< 6	< 0.75	< 2.5
n-Nitrosodi-n-propylamine	< 990	< 6	< 0.75	< 2.5
Pentachlorobenzene	120	NA	NA	< 0.01
Pentachlorophenol	480	< 24	< 1.9	< 6.2
Phenanthrene	2500	120	1.6	< 2.5
Phenol	2200	6	< 0.75	40
Pyrene	540	250	3.5	< 2.5
Tetrachlorobenzene, 1,2,4,5-	73	NA	NA	< 0.5
Tetrachlorophenol, 2,3,4,6-	280	NA	NA	< 0.01

Table 2 Maximum Source, Soil, Sediment, and Groundwater Concentrations

Parameter	Source (mg/Kg)	Soil (mg/Kg)	Sediment (mg/Kg)	Groundwater (mg/L)
Trichlorobenzene, 1,2,4-	1700	< 6	0.13	< 2.5
Trichlorophenol, 2,4,5-	< 990	< 1.2	< 1.9	< 6.2
Trichlorophenol, 2,4,6-	130	< 12	< 0.75	< 2.5
Antimony	617	< 0.86	5.8	0.01
Arsenic	573	3.4	29.2	75
Barium	1.73	3550	267	8.61
Beryllium	8.1	0.4	1.3	0.02
Cadmium	547	1.2	2.3	0.005
Chromium	12,000	92	79.2	0.87
Cobalt	NA	2.3	10.9	0.16
Copper	10,700	4.2	105	0.16
Lead	83,400	49	232	0.1
Manganese	NA	131	351	38.2
Mercury	46.4	< 0.14	0.25	0.01
Nickel	1140	4	15.9	3.82
Selenium	400	< 0.86	1.4	0.012
Silver	117	< 0.57	3.5	< 0.05
Thallium	6.5	< 1.1	1.9	0.004
Vanadium	NA	14.5	29.9	2.64
Zinc	97,400	21.2	323	0.85

TPH/Oil and Grease concentration from source areas were between 28.2 – 768,000 mg/L

NA – Not Analyzed

Table 3 Summary of Preliminary Action-Specific ARARs and TBCs

ARAR	Regulatory Citation	Specificity
Federal		
National Emission Standards for Hazardous Air Contaminants (NESHAP)	40 CFR 61	Air; Remedial Action
National Emission Standards for Hazardous Air Contaminants for Source Categories: Remediation	40 CFR 63.7880-63.7957	Air; Remedial Action
Oil Pollution Prevention	40 CFR 112	Water; Remedial Action
National Pollutant Discharge Elimination System (NPDES)	40 CFR 122	Water; Remedial Action
Technology-Based Treatment Requirements in Permits	40 CFR 125.3	Water; Remedial Action
Underground Injection Control Program	40 CFR 144	Water; Remedial Action
Underground Injection Control Program: Criteria and Standards	40 CFR 146	Water; Remedial Action
Hazardous Waste Injection Restrictions	40 CFR 148	Water; Remedial Action
Section 404(b)(1) Guidelines For Specification Of Disposal Sites For Dredged Or Fill Material	40 CFR 230	Ecological; Remedial Action
Hazardous Waste Management System: General	40 CFR 260	Waste; Remedial Action
Identification and Listing of Hazardous Waste	40 CFR 261	Waste; Remedial Action
Standards Applicable to Generators of Hazardous Waste	40 CFR 262 (A, B, C, D)	Waste; Remedial Action
Standards Applicable to Transporters of Hazardous Waste	40 CFR 263	Waste; Remedial Action
Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities	40 CFR 264	Waste; Remedial Action

Table 3 Summary of Preliminary Action-Specific ARARs and TBCs

ARAR	Regulatory Citation	Specificity
Land Disposal Restrictions	40 CFR 268	Waste; Remedial Action
Procedures for Planning and Implementing Off-Site Response Actions	40 CFR 300.440	Waste; Remedial Action
General Pretreatment Regulations for Existing and New Sources of Pollution for Publicly Owned Treatment Works (POTW)	40 CFR 401; 40 CFR 403	TBC; Water; Remedial Action
Effluent Guidelines and Standards – Landfills Point Source Category	40 CFR 445	Water; Remedial Action
Occupational Safety and Health Standards: Toxic and Hazardous Substances	29 CFR 1910.1000	Health and Safety; Remedial Action
Occupational Safety and Health Standards: Safety and Health Regulations for Construction	29 CFR 1910.1926	Health and Safety; Remedial Action
Department of Transportation (DOT); Hazardous Materials Regulations	49 CFR 171 - 180	TBC; Remedial Action
State of Texas		
Facilities (Emissions and Distance Limitations)	30 TAC 106.262.	Air; Remedial Action
Permits by Rule (Waste Processes and Remediation)	30 TAC 106.532 - 106.534	Air; Remedial Action
Control of Air Pollution from Volatile Organic Compounds (VOCs)	30 TAC 115	Air; Remedial Action
General Permits for Waste Discharges	30 TAC 205	Water; Remedial Action
Additional Conditions for Solid Waste Storage, Processing, or Disposal Permits	30 TAC 305.141-305.150	Waste; Remedial Action
Additional Conditions for Injection Well Permits	30 TAC 305.151-305.159	Water; Remedial Action
Permits for Land Treatment Demonstrations Using Field Tests or Laboratory Analyses	30 TAC 305.181-305.184	Waste; Remedial Action
Criteria and Standards for the National Pollutant Discharge Elimination System (NPDES)	30 TAC 308	Water; Remedial Action

Table 3 Summary of Preliminary Action-Specific ARARs and TBCs

ARAR	Regulatory Citation	Specificity
Toxic Pollutant Effluent Standards	30 TAC 314	Water; Remedial Action
Pretreatment for Existing and New Sources of Pollution	30 TAC 315	Water; Remedial Action
Control of Certain Activities by Rule: Discharge to Surface Waters From Treatment of Petroleum Fuel Substance Contaminated Waters	30 TAC 321.131 - 321.138	Water; Remedial Action
Used Oil Standards	30 TAC 324	Waste; Remedial Action
Spill Prevention and Control	30 TAC 327	Water; Remedial Action
Underground Injection Control; Standards for Class I Wells Other than Salt Cavern Solid Waste Disposal Wells	30 TAC 331.61-331.68	Water; Remedial Action
Underground and Aboveground Storage Tanks	30 TAC 334	Waste; Remedial Action
Industrial Solid Waste and Municipal Hazardous Waste	30 TAC 335	Waste; Remedial Action
Texas Risk Reduction Program	30 TAC 350	Waste and Water; Remedial Action
Other		
TexTin OU-4 Remedial Action	Not Applicable	Remedial Action
TexTin OU-4 NRD Settlement	Not Applicable	Remedial Action
CFR –Code of Federal Regulations TAC – Texas Administrative Code		

Table 4 Summary of Preliminary Chemical-Specific ARARs and TBCs

ARAR	Regulatory Citation	Specificity
Federal		
National Primary and Secondary Ambient Air Quality Standards (NAAQS)	40 CFR 50	TBC; Air; Remedial Action
Water Quality Standards	40 CFR 131	Water; Remedial Investigation
National Primary Drinking Water Regulations	40 CFR 141	Water; Remedial Investigation
Alternate Cleanup Levels	40 CFR 264.94	TBC; Waste; Remedial Action
Land Disposal Restrictions	40 CFR 268	Waste; Remedial Action
Occupational Safety and Health Standards: Toxic and Hazardous Substances	29 CFR 1910.1000	Health and Safety; Remedial Investigation and Remedial Action
Occupational Safety and Health Standards: Safety and Health Regulations for Construction	29 CFR 1910.1926	Health and Safety; Remedial Investigation and Remedial Action
USEPA Region 6 Human Health Medium-Specific Screening Levels	Not Applicable	TBC; Remedial Action
State of Texas		
Nuisance	30 TAC 101.4	Air; Remedial Action
Drinking Water Standards Governing Drinking Water Quality and Reporting Requirements for Public Water Supply Systems	30 TAC 290F	Water; Remedial Action
Texas Surface Water Quality Standards	30 TAC 307	Water; Remedial Action
Criteria and Standards for the National Pollutant Discharge Elimination System (NPDES)	30 TAC 308	Water; Remedial Action
Toxic Pollutant Effluent Standards	30 TAC 314	Water; Remedial Action
Used Oil Standards	30 TAC 324	Waste; Remedial Action

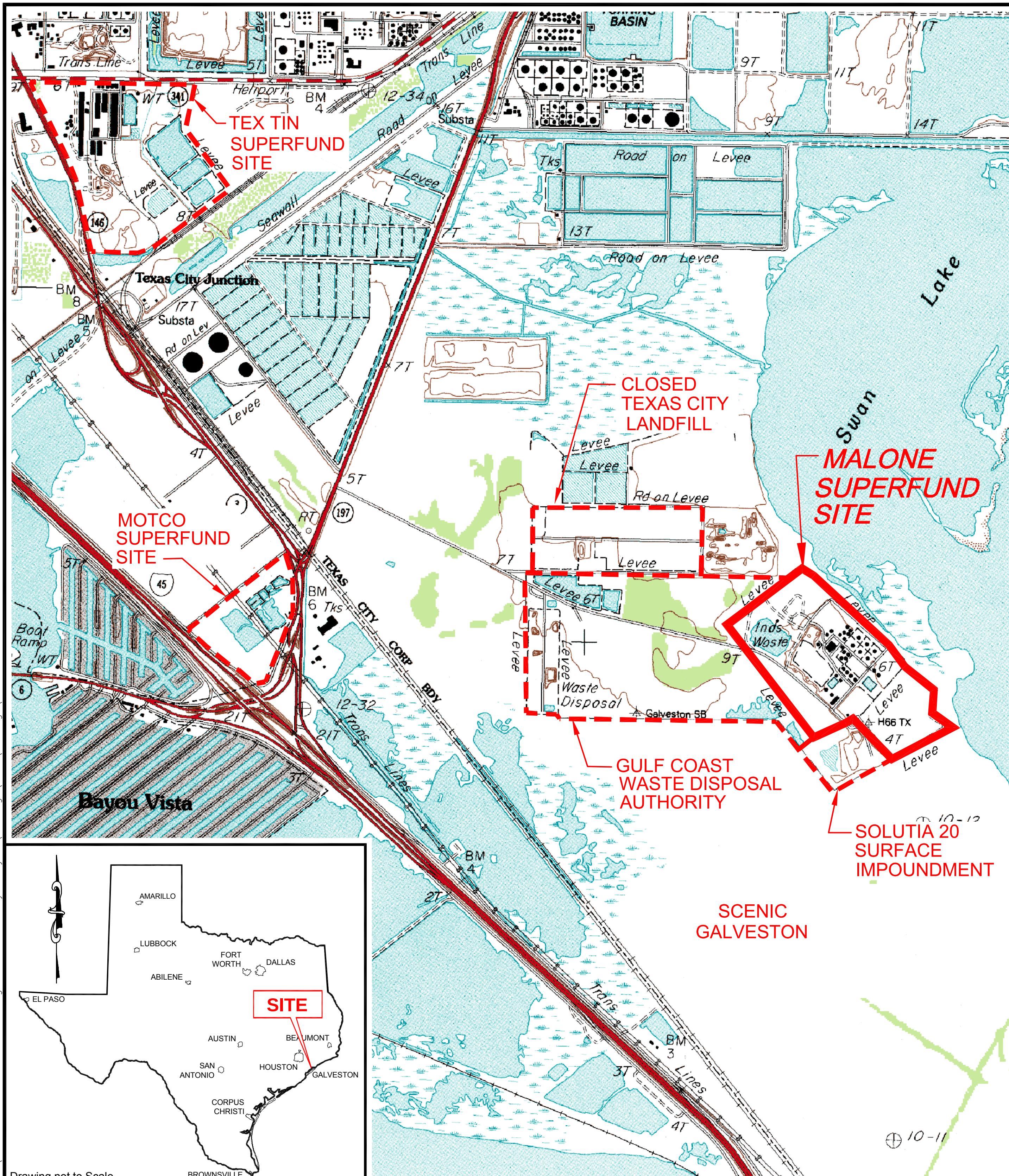
Table 4 Summary of Preliminary Chemical-Specific ARARs and TBCs

ARAR	Regulatory Citation	Specificity
Texas Risk Reduction Program	30 TAC 350	Waste and Water; Remedial Investigation and Remedial Action
CFR –Code of Federal Regulations TAC – Texas Administrative Code		

Table 5 Summary of Preliminary Location-Specific ARARs and TBCs

ARAR	Regulatory Citation	Specificity
Federal		
Statement of Procedures on Floodplain Management and Wetlands Protection	40 CFR 6, Appendix A	Ecological; Remedial Action
Protection of Wetlands	Executive Order 11990	Floodplain
Floodplain Management	Executive Order 11988; 40 CFR 6 Appendix A	Floodplain
Section 404(b)(1) Guidelines For Specification Of Disposal Sites For Dredged Or Fill Material	40 CFR 230	Ecological; Remedial Action
Ocean Dumping	40 CFR 231	Ecological; Remedial Action
Location Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities	40 CFR 264.18	Remedial Action
Endangered and Threatened Wildlife and Plants	50 CFR 17	Ecological; Remedial Action
Designated Critical Habitat	50 CFR 226.101-226.214	Ecological; Remedial Action
State of Texas		
Certain Historic Cemeteries	Texas Health and Safety Code Chapter 715	Remedial Action
CFR –Code of Federal Regulations TAC – Texas Administrative Code		

FIGURES



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APPROXIMATE SCALE IN FEET
SCALE= 1:24000

Source:
U.S.G.S. 7.5-minute series topographic map.
Virginia Point, Texas Quadrangle, 1994.

URS
9801 WESTHEIMER, SUITE 500
HOUSTON, TEXAS 77042
PH: (713) 914-6699
FAX: (713) 789-8404

Title:				
SITE LOCATION MAP				
Project: MALONE SERVICE CO. SUPERFUND SITE				
Client: MALONE COOPERATING PARTIES				
Scale: As Shown	Drawn by: SJF	Date: 10-13-04		
	Chk'd by: BPB	Date: 10-13-04		
Project No.: 811102.02	File Name: SITE-LOC	FIGURE No. 1		

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DATE: 10-13-04
TIME: 8:00:45

AERIAL PHOTO DATED NOV. 20, 2003

0 300 600
APPROXIMATE SCALE IN FEET

MALONE SERVICE CO. SUPERFUND SITE

URS
9801 Westheimer
Suite 500
Houston, Texas 77042
PH: (713) 914-6699
FAX: (713) 914-8404

SITE MAP

FILE NO. AERIAL–PHOTO

FIGURE NO. 2

SCALE: AS SHOWN	DRAWN BY: SJF	DATE: 10–13–04
	CHKD. BY: BPB	DATE: 10–13–04

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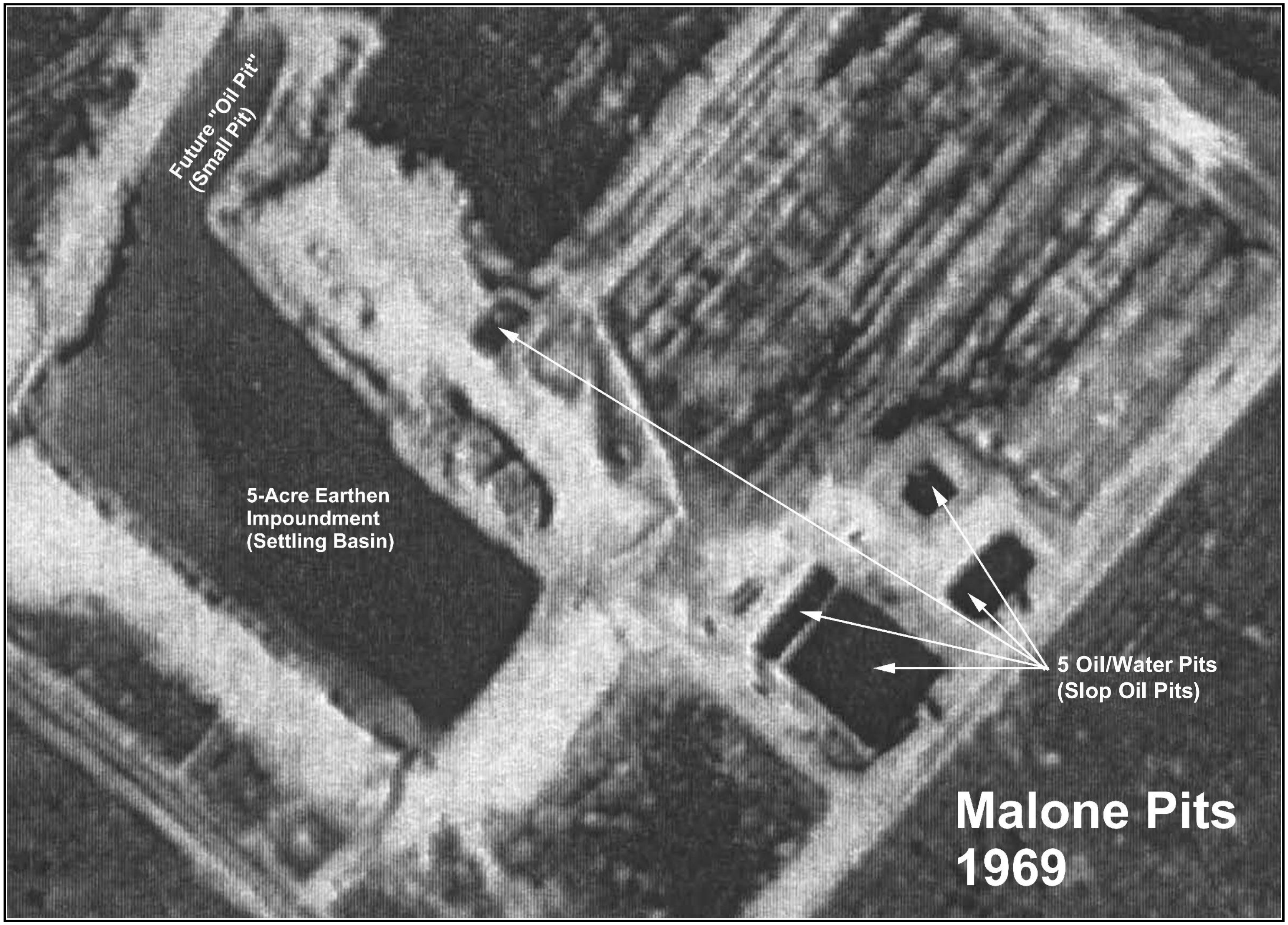

SOURCE: EPA

NOTE: DRAWING NOT TO SCALE

URS
9801 WESTHEIMER, SUITE 500
HOUSTON, TEXAS 77042
PH: (713) 914-6699
FAX: (713) 789-8404

Title: 1969 AERIAL PHOTOGRAPH			
Project: MALONE SERVICE CO. SUPERFUND SITE			
Client: MALONE COOPERATING PARTIES			
Scale: AS SHOWN	Drawn by: NAB	Date: 06/08/04	
	Chk'd by: BB	Date: 06/08/04	
Project No.: 811102.02	File Name: AERIAL 1969.DWG	FIGURE No. 3	

0 1200 2400

APPROXIMATE SCALE IN FEET

Source:
U.S.G.S. 7.5-minute series topographic map.
Virginia Point, Texas Quadrangle, 1994.

URS
9801 WESTHEIMER, SUITE 500
HOUSTON, TEXAS 77042
PH: (713) 914-6699
FAX: (713) 789-8404

Scale: As Shown	Drawn by: SJF	Date: 5-3-05			
	Chk'd by: BB	Date: 5-3-05			

Title: **SOIL / SEDIMENT SAMPLE LOCATIONS**

Project: **MALONE SERVICE CO. SUPERFUND SITE**

Client: **MALONE COOPERATING PARTIES**

Project No.:	File Name:	FIGURE No.
811102	SEDIMENT-SAMPLE-LOC	4

FILE NAME: MALONE-SEDIMENT-SAMPLE-LOC.dwg
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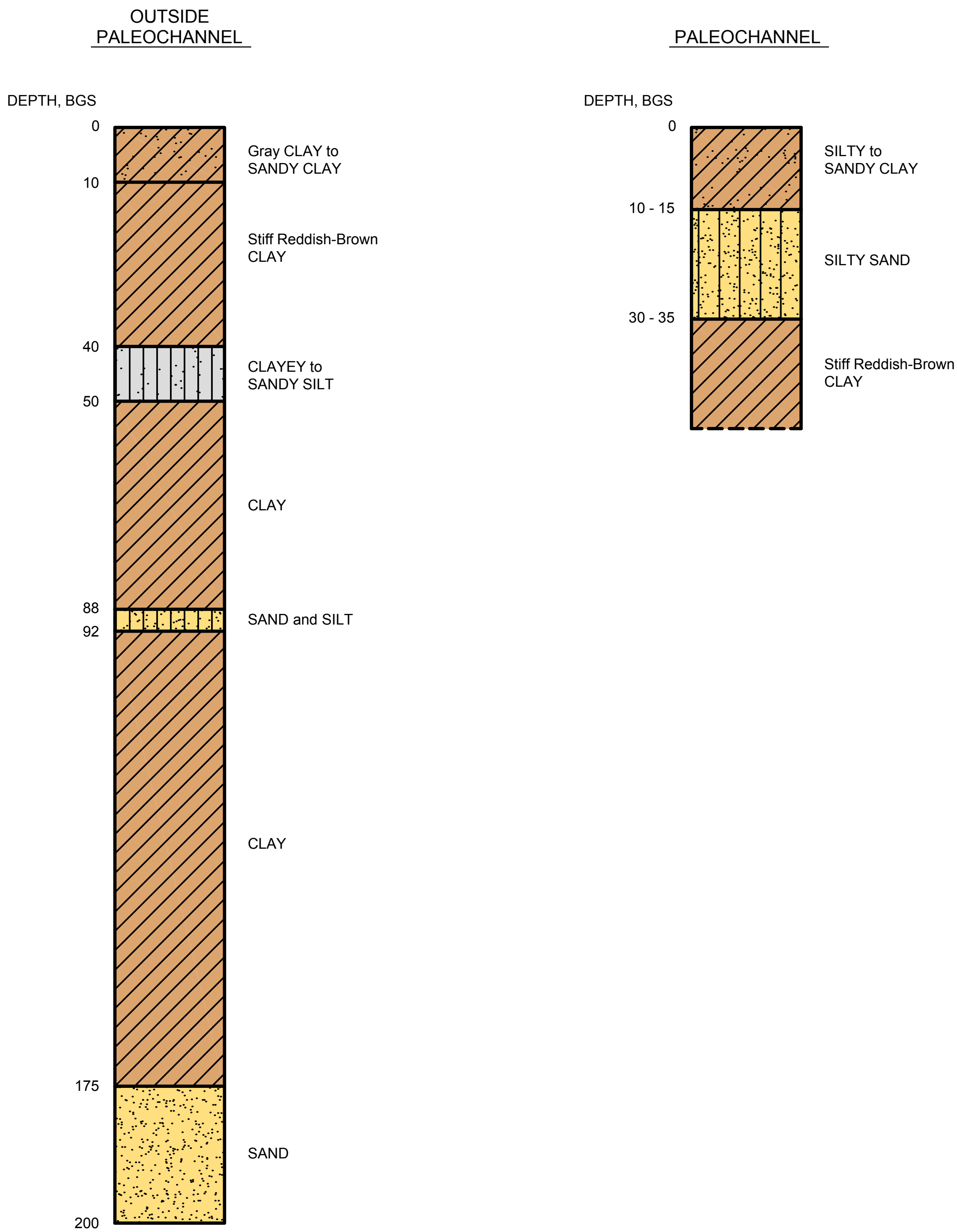

URS
9801 WESTHEIMER, SUITE 500
HOUSTON, TEXAS 77042
PH: (713) 914-6699
FAX: (713) 789-8404

Title: **CONCEPTUAL LITHOLOGIC MODEL**					
Project: **MALONE SERVICE CO. SUPERFUND SITE**					
Client: **MALONE COOPERATING PARTIES**					
Scale: As Shown	Drawn by: SJF	Date: 10-4-04	Project No.: 811102.02	File Name: LITHOLOGIC-MODEL.DWG	FIGURE No. **5**
	Chk'd by: BPB	Date: 10-4-04			

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DATE: 10-4-04
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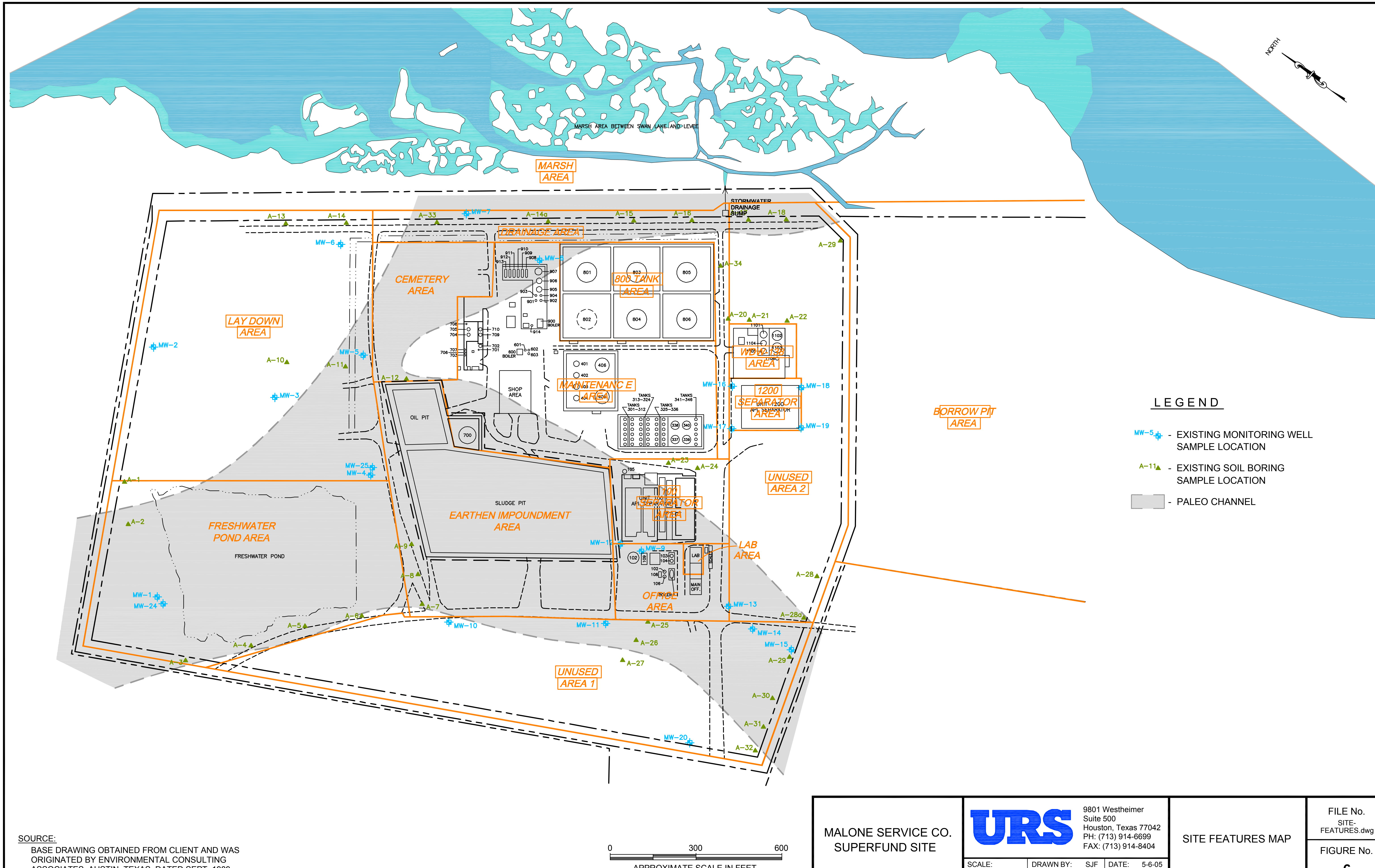

SOURCE:
BASE DRAWING OBTAINED FROM CLIENT AND WAS ORIGINATED BY ENVIRONMENTAL CONSULTING ASSOCIATES, AUSTIN, TEXAS, DATED SEPT. 1989.

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MALONE SERVICE CO.
SUPERFUND SITE

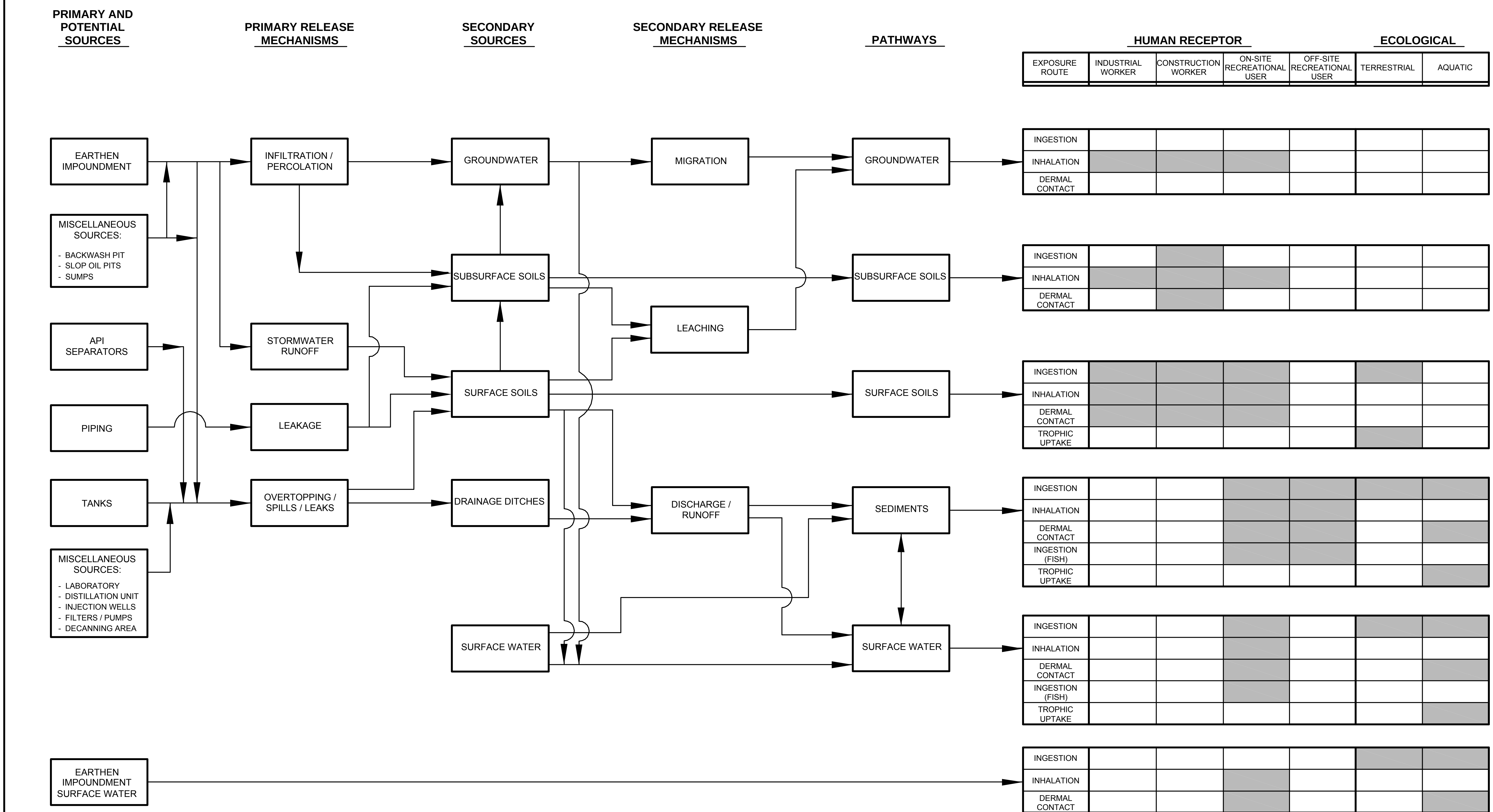
URS
9801 Westheimer
Suite 500
Houston, Texas 77042
PH: (713) 914-6699
FAX: (713) 914-8404

SCALE: AS SHOWN	DRAWN BY: SJF	DATE: 5-6-05
	CHKD BY: BB	DATE: 5-6-05

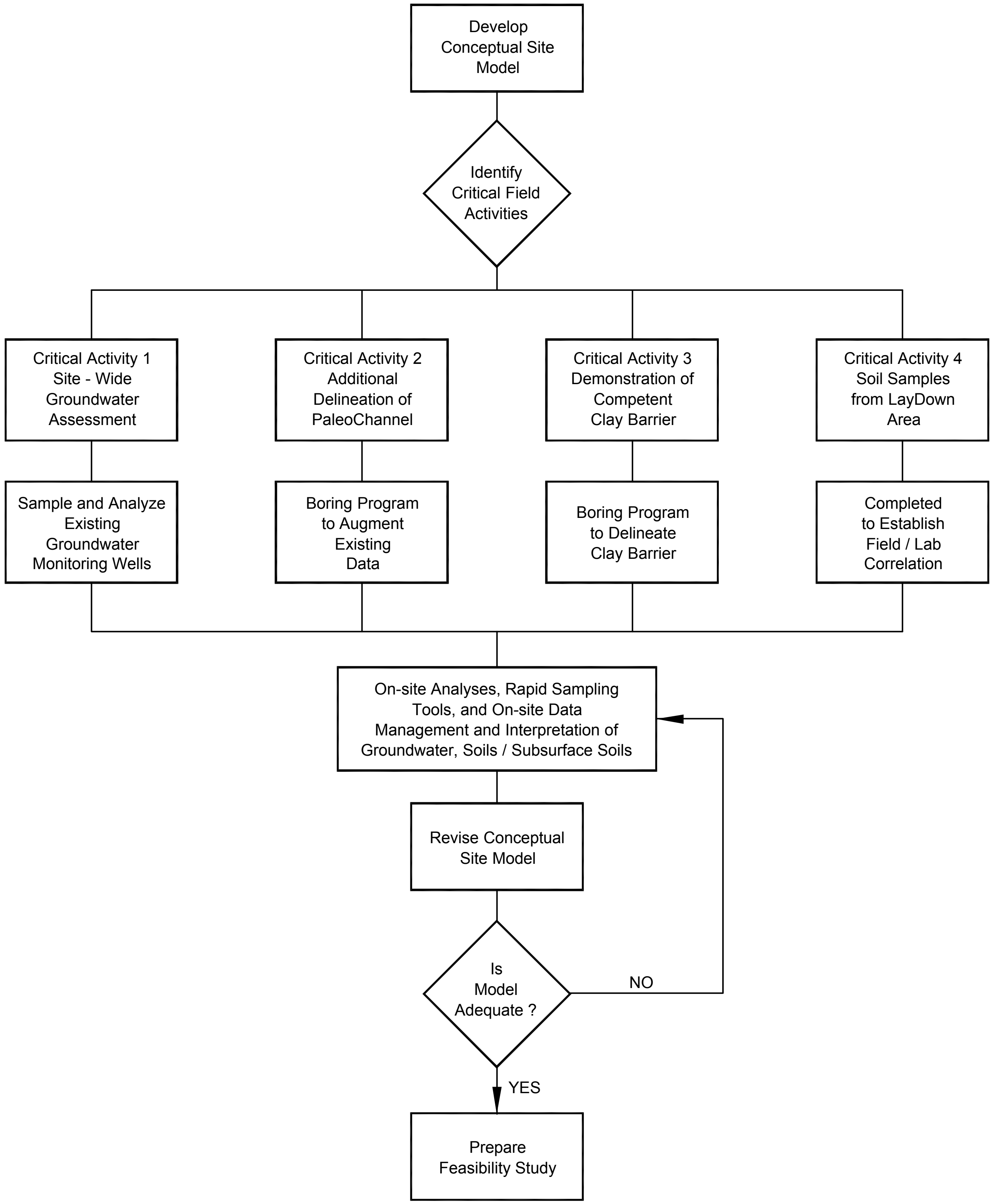
SITE FEATURES MAP

FILE No.
SITE-FEATURES.dwg

FIGURE No.
6



MALONE SERVICE CO. SUPERFUND SITE	URS 9801 Westheimer Suite 500 Houston, Texas 77042 PH: (713) 914-6699 FAX: (713) 914-8404	CONCEPTUAL SITE MODEL
	SCALE: AS SHOWN / DRAWN BY: SJF / DATE: 5-6-05 / CHKD. BY: BPB / DATE: 5-6-05	FILE NO. CONCEP-MODEL FIGURE NO. 7



URS

9801 WESTHEIMER, SUITE 500
HOUSTON, TEXAS 77042
PH: (713) 914-6699
FAX: (713) 789-8404

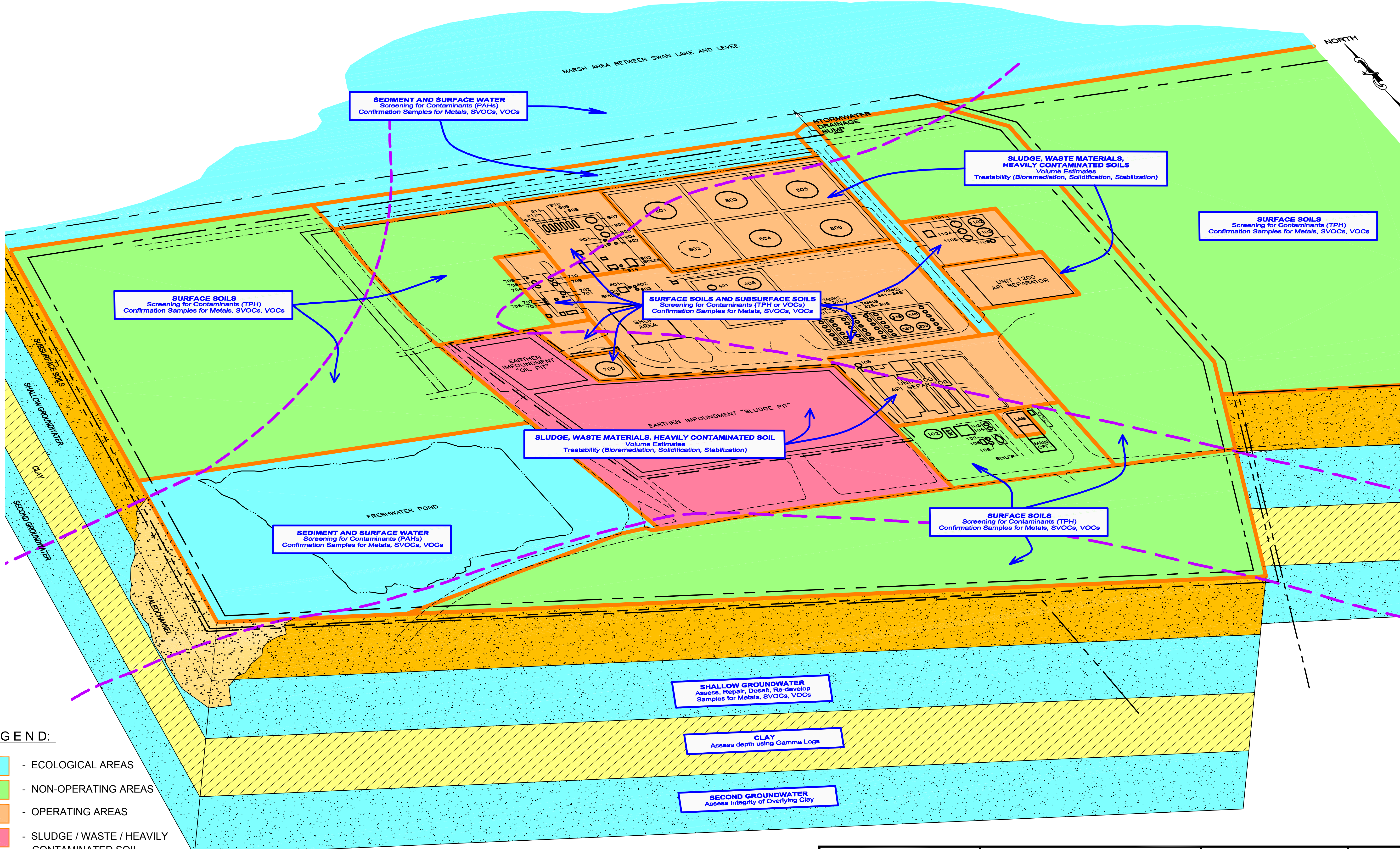
Title: **TRIAD APPROACH LOGIC DIAGRAM**

Project: **MALONE SERVICE CO. SUPERFUND SITE**

Client: **MALONE COOPERATING PARTIES**

Scale:	Drawn by:	Date:	Project No.:	File Name:	FIGURE No.
As Shown	SJF	10-29-04	811102.02	Triad Approach Diagram.dwg	8
	Chk'd by: BPB	Date: 10-29-04			

DATE: 10-13-04 TIME: 8:00:45 FILE NAME: MALONE-TRIAD APPROACH DIAGRAM.dwg FILE PATH: K:\ELM\811102.Malone.Remedial Investigation & Feasibility Study.03\Drawings\Acad\Drawings\.....



LEGEND:

- ECOLOGICAL AREAS
- NON-OPERATING AREAS
- OPERATING AREAS
- SLUDGE / WASTE / HEAVILY CONTAMINATED SOIL
- BOUNDARY PALEOCHANNEL

SOURCE:
BASE DRAWING OBTAINED FROM CLIENT AND WAS ORIGINATED BY ENVIRONMENTAL CONSULTING ASSOCIATES, AUSTIN, TEXAS, DATED SEPT. 1989.

0 200 400
APPROXIMATE SCALE IN FEET

MALONE SERVICE CO. SUPERFUND SITE	URS	9801 Westheimer Suite 500 Houston, Texas 77042 PH: (713) 914-6699 FAX: (713) 914-8404	3-D CONCEPTUAL SITE MODEL	FILE No. IMPACTED AREAS OF FACILITY.DWG
	SCALE: AS SHOWN	DRAWN BY: NAB DATE: 10-13-04 CHKD BY: BB DATE: 10-13-04		FIGURE No. 9

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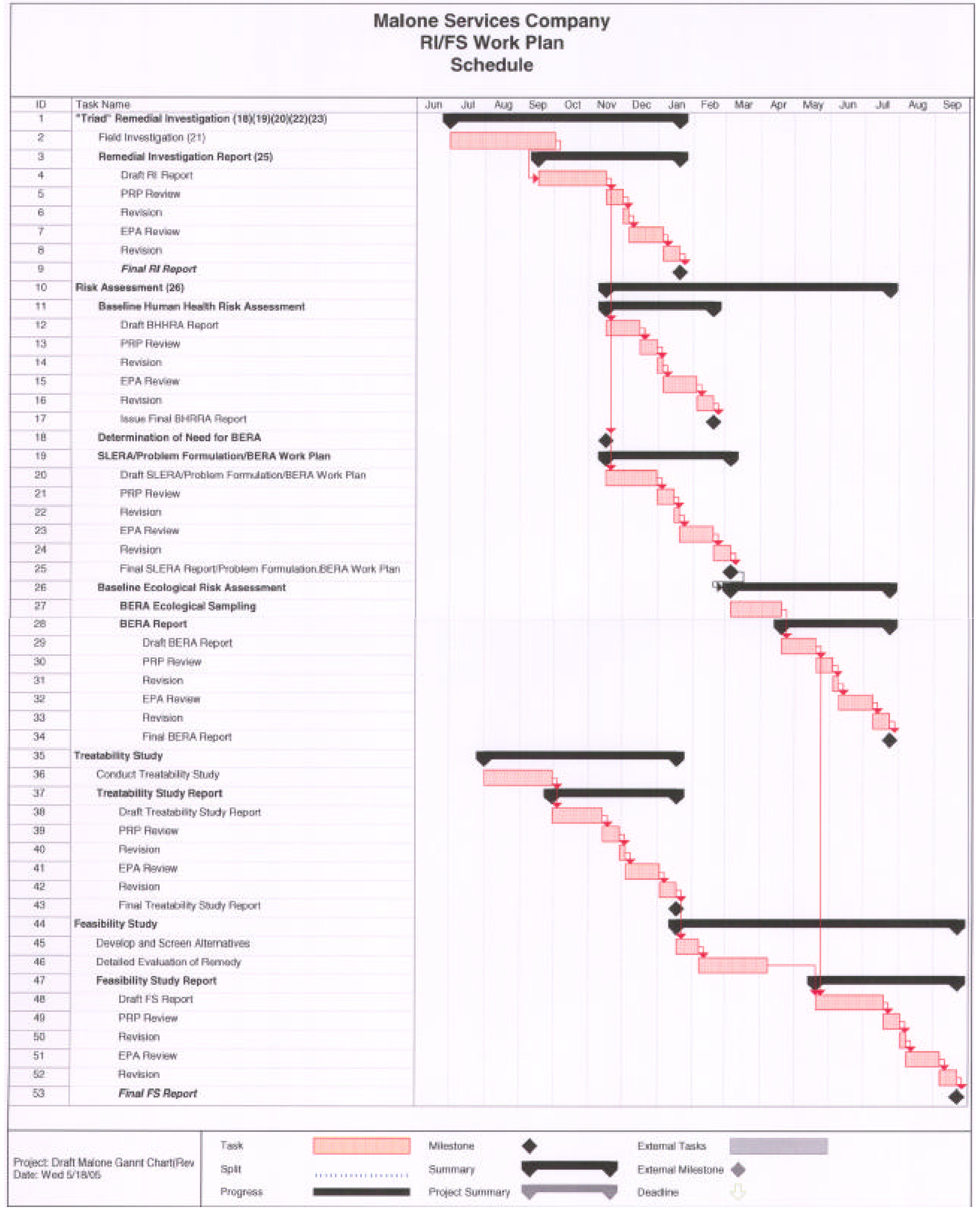

MALONE SERVICE CO. SUPERFUND SITE	URS 9801 Westheimer Suite 500 Houston, Texas 77042 PH: (713) 914-6699 FAX: (713) 914-8404		RI/FS WORK PLAN	FILE No. WORK PLAN SCHEDULE.dwg
	SCALE: AS SHOWN	DRAWN BY: SJF DATE: 5-6-05 CHKD BY: BB DATE: 5-6-05		FIGURE No. 10

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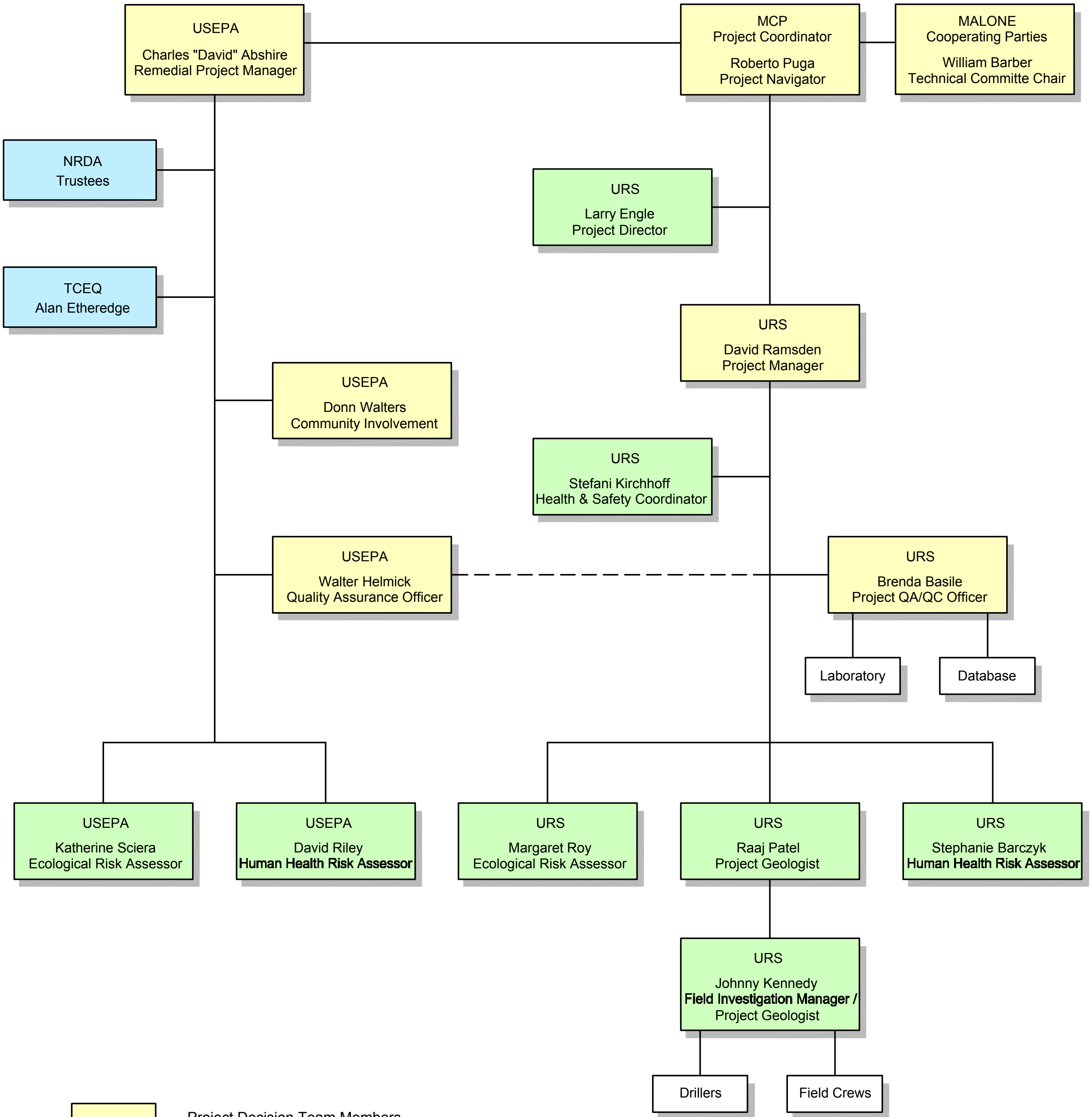

- Project Decision Team Members
- Technical Expertise Team Members
- Regulatory Stakeholders
- Subcontractors (as needed)
- Formal Project Communications Line
- Informal Project Communcations Line (as needed)

URS
9801 WESTHEIMER, SUITE 500
HOUSTON, TEXAS 77042
PH: (713) 914-6699
FAX: (713) 789-8404

Title: **PROJECT ORGANIZATION**

Project: **MALONE SERVICE CO. SUPERFUND SITE**

Client: **MALONE COOPERATING PARTIES**

Scale:	Drawn by:	Date:	Project No.:	File Name:	FIGURE No.
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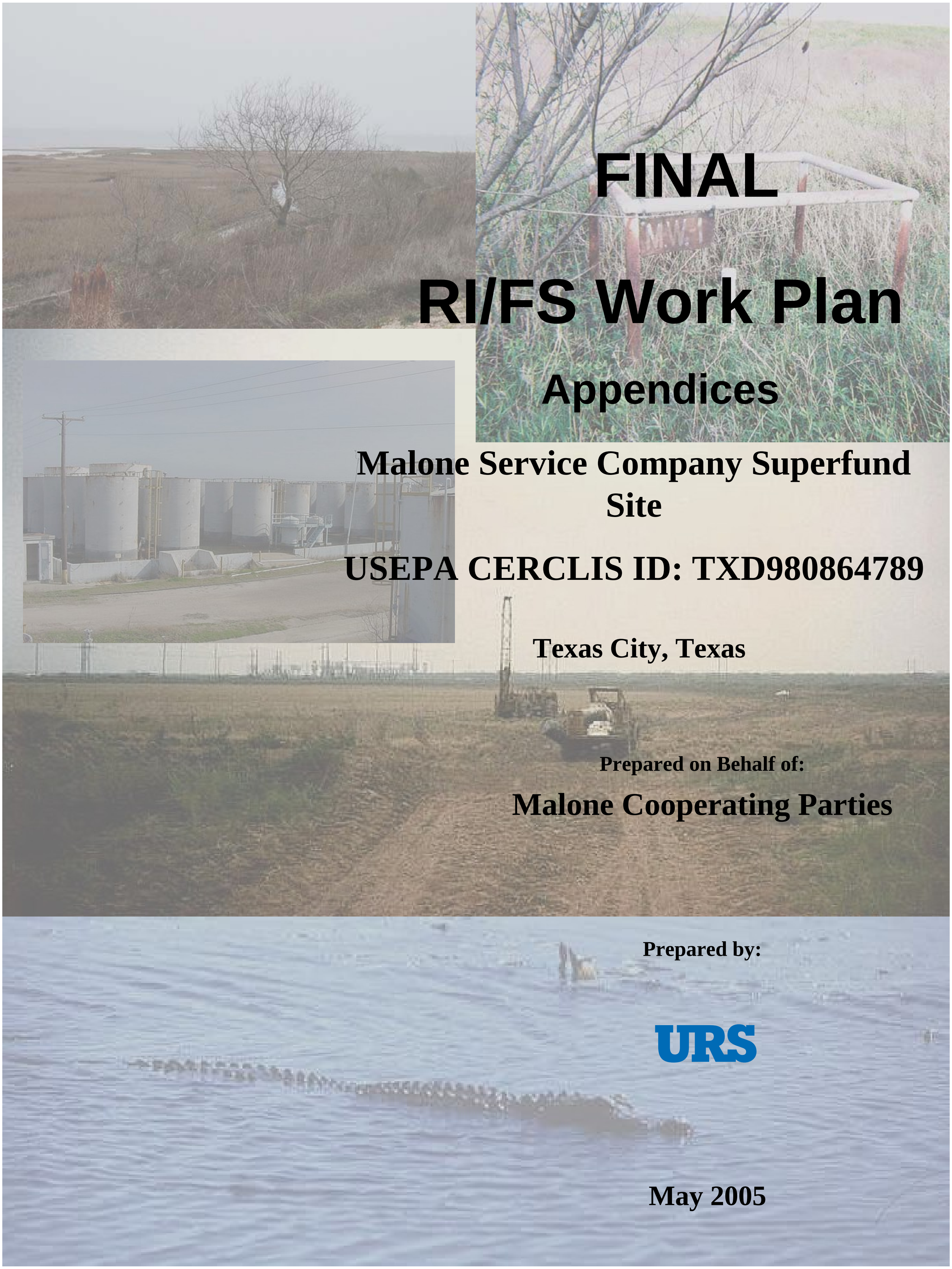

FINAL

RI/FS Work Plan

Appendices

Malone Service Company Superfund Site

USEPA CERCLIS ID: TXD980864789

Texas City, Texas

Prepared on Behalf of:

Malone Cooperating Parties

Prepared by:

URS

May 2005

APPENDICES

FINAL

RI/FS Work Plan

Appendix A Field Sampling Plan

Malone Service Company Superfund Site

USEPA CERCLIS ID: TXD980864789

Texas City, Texas

Prepared on Behalf of:

Malone Cooperating Parties

Prepared by:

URS

May 2005

FINAL

RI/FS Work Plan

Appendix A

Field Sampling Plan

Malone Service Company Superfund Site

USEPA CERCLIS ID: TXD980864789

Texas City, Texas

Prepared on Behalf of:

Malone Cooperating Parties

Prepared by:

URS

May 2005

Appendix A – Field Sampling Plan (FSP)

(Bound Separately)

FINAL

RI/FS Work Plan

Appendices B through G

Malone Service Company Superfund Site

USEPA CERCLIS ID: TXD980864789

Texas City, Texas

Prepared on Behalf of:

Malone Cooperating Parties

Prepared by:

URS

May 2005

Appendix B – Quality Assurance Project Plan (QAPP)

Appendix C – Community Relations Plan

(To be Supplied by EPA)

Appendix D – Data Management Plan

TABLE OF CONTENTS

TABLES

FIGURES

ACRONYM LIST

CAS	Chemical Abstracts Service
CD	Compact Disk
C-O-C	Chain-of-Custody
DMP	Data Management Plan
DQO	Data Quality Objectives
EDD	Electronic Data Deliverable
FS	Feasibility Study
FSP	Field Sampling Plan
MCP	Malone Cooperating Parties
MDL	Method Detection Limit
mg/Kg	Milligrams per kilograms
MQL	Method Quantitation Limit
MSC	Malone Service Company
NPL	National Priorities List
PDF	Portable Data Format
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
SOW	Statement of Work
TOC	Total Organic Carbon
URS	URS Corporation
USEPA	United States Environmental Protection Agency
VPN	Virtual Private Network

1.0 DATA MANAGEMENT PLAN

The Malone Service Company, Inc. (MSC) site is located in Texas City, Galveston County, Texas, in a former industrial and petrochemical area constructed on the shores of Swan Lake and Galveston Bay. The MSC Superfund Site was proposed to the National Priorities List (NPL) on August 24, 2000, and was placed on the NPL on June 14, 2001. An Administrative Order on Consent (the Order) for the remedial investigation/feasibility study (RI/FS) was issued by the United States Environmental Protection Agency (USEPA) on September 29, 2003 to the Malone Cooperating Parties (Respondents).

1.1 Objectives

Included with the Order is a Statement of Work (SOW) that describes the requirements for an RI/FS Study Work Plan and the associated Field Sampling Plan (FSP) and Quality Assurance Project Plan (QAPP) (USEPA 2003). The Malone Cooperating Parties (MCP) are required to develop a Data Management Plan (DMP) as part of the RI/FS Work Plan deliverable. The DMP for the MSC RI/FS includes the process for planning, collecting, evaluating, and reporting information gathered during the RI and FS activities. The DMP must meet the requirements of the SOW and the USEPA RI/FS guidance (USEPA 1988). The goal of the data management procedures are to consistently document the quality and validity of the field and laboratory data compiled during the RI and FS.

The objectives of this DMP are to:

- identify and set up data documentation materials and procedures;
- present the format for electronic deliverables;
- identify project-related progress reporting procedures and documents;
- present the format for field measurements, analytical results and validated results; and
- identify project file requirements.

1.2 Data Management Process

Table 1 presents the details of the data management process to be followed for this project, including specific tasks to be performed, the person designated to perform each task, and guidance on when the task is to be performed. The foundation of the data management process is the MCP database, which will contain the majority of the project analytical and field data. The MCP database will maintain the analytical and field data in a secure, structured environment and will minimize the potential for miscommunications during concurrent site activities, as well as when the project transitions between the various phases. Other information and physical records pertaining to project activities (log books, reports, maps, photographs, etc.) will be maintained in the Project Central File System.

1.3 Project Team

Members of the RI/FS project team who are supervising portions of the data management process (as described in Table 1) are as follows:

Project Manager .... David K. Ramsden

Field Investigation Manager ....Johnny Kennedy

Project Chemist/Quality Assurance Officer .... Brenda Basile

Project Database Manager .... Pete Conwell

Other personnel, including the Database Management Assistant, the Sampling Tracking Coordinator and field crews, will participate in the data management process. For a complete project organization chart, please refer to the QAPP. Team member responsibilities are listed in Table 2.

1.4 USEPA Data Requirements

As required by the Order, data compiled during the RI must be electronically supplied to the USEPA in ArcView® Version 3.2 format. All RI submittals, except for field notes and logbooks, shall be submitted electronically in Microsoft Word® 2000 format and in a searchable portable document format (PDF) (Adobe® Acrobat™ 5).

Field and analytical data will be maintained in the Earthsoft EQuIS® database. Table 3 lists the format for sample data.

Analytical measurements should include, at a minimum, the following information:

1. laboratory sample identification
2. field sample identification
3. method
4. analyte
5. concentration
6. sample detection limit, if applicable
7. concentration units

Laboratory analytical data will be submitted in the URS electronic data deliverable (EDD) format specified in Table 4. EDD formats for survey and field parameters are specified in Tables 5 and 6, respectively. The EDD format for lithologic data is specified in Table 7. Sample type, field parameters, lithologic and screening data will be hand-entered into the database using the EDD (or equivalent) format.

2.0 DATA COLLECTION

Proposed sampling locations, matrices, and test methods, as outlined in the FSP, will be entered into the database prior to the sampling phase. The database information will be used to produce a sampling kit that includes a sampling schedule, sample labels, and chain-of-custodies (C-O-Cs). Additionally, the database will be used to track sample progress through the various stages from collection to data validation.

2.1 Station and Sample Identifications

Each sample collection location will be assigned a unique station identifier (StationID). StationIDs are generated using a station group code, which indicates the investigation unit from which the sample was collected (i.e., Sludge Pit [SP], Oil Pit [OP], estuarine marsh area [EM], Monitoring Well [MW], etc.) and the matrix type (see Table 8 for approved investigation unit and matrix codes), followed by an integer unique to that station group. For example, StationID "EM-SD-06" corresponds to sample station 6 (06) for the collection of sediment (SD) within the estuarine marsh adjacent to the site. StationID MW-GW-001 corresponds to a groundwater sample from monitoring well 01. It should be noted that the integer component of the station group code may not begin with "001" for all sample areas and matrix types, and numbering may not always be consecutive. In the case of additional sampling in a particular investigation unit, the integer sequence will continue from the last used integer.

SampleIDs will include a sample group code, which concatenates the station group code and the date sampled. Soil, sediment, sludge and surface water samples will include the sample depth. For example, the sample identifier for a sediment sample collected from StationID SL-SD-06 on January 1, 2005 at 0.5 feet is EMSD06-010105-005. The sample identifier for a sample collected from StationID MW-GW-001 on December 31, 2005 is MWGW001-123105.

2.2 Sample Management

After sampling information is entered into the system, the data management database tracks the sample status by means of several sample tracking reports. In general, once a sample label is generated, the laboratory receipt, delivery of laboratory data, uploading process and data validation steps are tracked and documented by the database management system.

2.3 Sample Labels and Chain of Custody Forms

Pre-printed bottle labels (see Figure 1 for examples) will be generated from the data management system. Each label will specify the destination laboratory, SampleID, StationID, test method, and other pertinent information, such as date, matrix, bottle type and preservation. As samples are collected, the sampler will record on each bottle label the time of collection and depth interval (if applicable), and then sign the bottle label. Sample teams are responsible for affixing labels to the appropriate sample container(s) at the time of sample collection. The sampling time and date, as well as other relevant information (such as depth interval) will be added to the database on a daily basis as samples are received by the Sampling Tracking Coordinator. The data management system will produce the C-O-C documentation (See Figure 2) which is delivered to the laboratory with the samples.

2.4 QA/QC Samples

The appropriate quality assurance and quality control (QA/QC) samples, as required to meet the project-specific Data Quality Objectives (DQOs) are documented in the QAPP (Appendix B of the RI/FS Work Plan). The Field Investigation Manager will be responsible for sequencing the collection and analysis of the QA/QC samples so appropriate samples are collected in each analytical batch.

QA/QC samples are designated in the station group code. Table 8 lists the approved station group codes for QA/QC samples. QA/QC SampleIDs will include a sample group code, which concatenates the station group code for the QA/QC sample, the station group code for the investigation unit, and the date sampled. For example, the sample identifier for a trip blank sample submitted January 1, 2005 with samples collected in Swan Lake is TBSW01-010105. The sample identifier for an equipment blank sample collected while sampling groundwater on December 31, 2005 is EBGW01-123105.

2.5 Laboratory Data

A unique laboratory batch and SampleID will be used for correspondence with the laboratory. The analytical data will be delivered in an URS-specified electronic format from the laboratory with a reference to each applicable laboratory batch and SampleID. Ten percent of the electronic laboratory deliverables will be reviewed to verify that the electronic information matches the hard copy laboratory reports. As the electronic data is loaded, the data management database will verify that the appropriate analytical tests were performed as identified for the StationID and on the C-O-C forms. Several automated diagnostic checks are run on the laboratory deliverable to evaluate the integrity and completeness of the electronic deliverable prior to loading it into the data management database.

2.6 Survey Data

The Field Investigation Manager will collect the vertical elevations and horizontal coordinate information and submit the data in an electronic format that references each applicable StationID to the Data Management Assistant for inclusion in the database. Survey coordinates will be geo-referenced to Texas state plane coordinates. This information will be loaded into the data management database to provide location data for each StationID. Populating the database with the vertical and horizontal coordinate information will enable the MCP to provide the USEPA with the electronic data in ArcView® format.

2.7 Other Data

The following types of field data will be entered into the database data tables: water level data, boring stratigraphy, and field measurements. Other data elements will be added to this list as project needs and activities evolve. Field photographs will be geo-referenced in the ArcView® database.

3.0 DATA EVALUATION

The data evaluation process includes activities to assess the validity and technical significance of the analytical data.

3.1 Data Validation

The project chemist will be responsible for the review of the Temporary Database and supporting hard-copy reports to assess the quality of the data with respect to the project-specific measurement quality objectives prior to the release of the Permanent Database for reporting. Data validation procedures are specified in the QAPP (Appendix B of the RI/FS Work Plan). The original hard copy laboratory reports will be edited in green pen by the data validation personnel. Validation qualifiers will be applied to the Temporary Database and the data will be assigned a validation code to denote the level of data review.

3.2 Technical Evaluation

Once the information in the database is complete and validated, the Temporary Database will be merged to the Permanent Database. EQuIS® utilizes the Temporary Database as temporary storage for analyzing EDD-specific constraints (such as data types, field lengths, duplicate records within an EDD, etc.) prior to merging into the permanent database, which is typically done immediately after importing an EDD into the Temporary Database. Additional constraints (such as duplicate records within the Permanent Database, parent sample records for duplicate samples, etc.) are evaluated when the data is moved from temporary database into the permanent database.

The Permanent Database will be used by various members of the project team to support technical evaluations of site conditions and remediation strategies. The expected data evaluation activities include statistical reduction, nature and extent evaluation, trend analysis, ecological and human health risk assessments, and feasibility studies.

4.0 REPORTING

Statistical analyses, data listings, and analytical reports will be generated from the Permanent Database with the oversight of the Project Data Manager.

4.1 Progress Reporting Procedures and Documents

Project related reporting requirements are listed in Section VII (List of Deliverables and Schedule) in the Order. These deliverables include:

1. Monthly Progress Reports
2. Analytical Data Summaries
3. Remedial Investigation Report
4. Baseline Human Health Risk Assessment
5. Screening Level Ecological Risk Assessment
6. Feasibility Study Report

Analytical data will be summarized monthly and included as an attachment to the Monthly Progress Reports. In addition, sample status (samples collected, analyzed, and validated) for each investigation unit will also be summarized in the Monthly Progress Reports.

In addition, the Permanent Database will be the primary tool used by the Project Manager, Risk Assessors, Project Geologist, and Project Chemist to prepare other project reports such as the Remedial Investigation Report, Baseline Human Health Risk Assessment, Screening Level Risk Assessment, and Feasibility Study Report. Access to the database will be limited to trained personnel to minimize the potential for database corruption. Routine queries for maximums, averages, and data for statistical calculations or modeling will be automated by the Project Database Manager.

4.2 Data Presentation Format

A consistent data presentation format will be developed by the Project Chemist and the Project Database Manager prior to preparation of the project deliverables. Input will be solicited from the primary data users, the Risk Assessors, the Project Geologist, and the Project Manager.

4.2.1 Tabular Data

The data presentation format, along with the consistent identification of StationIDs, will minimize reporting time and provide project personnel with the ability to quickly locate significant information. In general, tabular displays will be formatted in accordance with industry conventions. Analyte or field parameters will be listed vertically in the far left column followed by a column for units. The results for each analytical or field sample will be listed to the right of the parameter and unit columns. At a minimum, row headings for each of the analytical or field sample columns will include StationID, Sample ID, and date sampled. Additional rows may be added to clarify the data presentation. Tabular data will be sorted by media and investigation unit.

The following data will be presented in tabular displays:

1. field measurements;
2. analytical data for each medium with a listing of each constituent monitored;
3. data reduction from statistical analyses;
4. data sorting by potential stratification factors (e.g., location, subsurface stratigraphy, topography, etc.); and
5. summary data.

4.2.2 Graphical Data

Graphical displays, including bar graphs, line graphs, area or plan maps, isopleth plots, cross-section plots or transects, cross-section and/or fence diagrams, and three-dimensional graphs, will be used to present the following data:

1. sampling locations, depths, and/or intervals;
2. boundaries of investigation unit and areas where additional data is required;
3. concentration and depth of sample for analytes at sampling locations;
4. geographical extent of contamination;
5. analyte concentrations, averages, and maximums;
6. changes in concentration relative to distance, time, depth, or other parameters;
7. features affecting transport and receptors;
8. geology (stratigraphy and structure); and
9. hydrogeology (e.g., water bearing units, flow direction, etc.) including geologic and hydrogeologic interconnections with adjacent surface water bodies.

Specific formats for graphical data presentation cannot be defined in advance. However, industry conventions such as facility and geographic north arrows on area or plan maps and isopleth plots will be followed.

5.0 RECORDKEEPING

Records, documents, and other information pertaining to the MSC Superfund Site, as well as documentation used to prepare the required deliverables, will be maintained for a minimum of six years after completion of the work and the termination of the Order. Records pertaining to project administrative activities, technical analysis, analytical data, and decision-making will be maintained by the MCP. Administrative documents include work plans, contracts, change orders, key personnel changes, and communications between MCP, the Texas Commission on Environmental Quality and USEPA regarding management or administrative aspects of the RI/FS. Technical analysis documents, including field books, labels, shipping and C-O-C forms, as well as analytical data, will be generated and maintained as described in the QAPP. Decision-making documents include minutes of meetings between MCP members and/or contractors that involve decisions affecting technical aspects of the RI/FS. The sections below described the paper filing system, the electronic filing system, archival procedures, and the security system.

5.1 Project Central File System

The project files will be maintained at both the URS office and, during the RI investigation, at the site. The sections below describe the filing system for office and field files and archival procedures.

5.1.1 Office System

The Project Central File System contains project files, including the project field records, QA records, deliverables, and other documents. In addition to storing hard copy documentation in the Project Central File System, a directory or subdirectory is maintained for each active project on the office local area network, which contains the same documentation in electronic format, if available.

5.1.2 Site System

A central file system will also be established at the site during site investigation activities. The files maintained at the site will only be those necessary to implement the RI. The following information will be stored in the file system:

1. Health and Safety Plan
2. health and safety records (daily safety meetings, daily safety task analysis worksheets, work permits, etc.)
3. C-O-Cs
4. sample labels
5. field logs and notebooks
6. work plans (FSP, QAPP, DMP, etc.)

Upon completion of the field activities, site files will be transferred to the URS office and incorporated into the Project Central File System.

5.1.3 Archival

The Project Manager completes and updates the Project Central File System, purges unnecessary information, specifies the retention time required by the Order, and transmits all project and quality-related records to the MCP or USEPA, if requested, and to the office non-active files for retention. Originals (or copies) of documents transmitted to the USEPA shall be retained.

All documents sent to the Project Central File System will be cataloged and filed under the job number. A Document Retention Log or database file, containing the job name and number, client, document description, retention time, date transferred to client, date stored, location, box number, and date to review for destruction, shall be prepared by the Project Manager. Types of documents included in the archival are:

- proposals
- design specifications
- contracts and amendments
- reports and studies
- change orders
- engineer's estimates
- project correspondence
- Independent Technical Reviews
- daily field reports
- test reports
- design calculations
- logbooks or field books
- computer program documentation
- photographs
- design drawings
- QA audits
- Quality Assurance Plans (project-specific)

5.2 Electronic Files

Project managers maintain the current data files for their project. These data files are stored on the office server. A standard project file format has been established for each project. The file format includes directories for data, deliverables (both draft and final deliverables), communications (internal, minutes, client, agencies, etc.), drawings, reference materials, and project management (budget, schedule, subcontracts, etc.).

5.3 Data Security System

Both paper and electronic files must be secured for reconstructing project activities, preparing the RI and FS reports, and minimizing free access to project records.

5.3.1 Paper Files

The Project Central File System is stored within a central location in the URS office. Access to the office requires a key or access card. Visitors must enter the office through a manned reception area, sign in and be escorted by an employee.

Files located on-site will be stored in a locked file cabinet located in the project trailer. Visitors to the project trailer must sign in and be escorted by an employee. The project trailer will be kept locked if URS personnel are not inside. The keys to the file cabinet will be controlled by the Field Investigation Manager and the Project Manager. In order to minimize the potential for data loss, files will be transferred to the Project Central File System as soon as they are not required at the site.

5.3.2 Electronic Files

URS has implemented a communications system (including but not limited to electronic mail, telephones, video conferencing, voice mail, facsimiles, and connections to the Internet and other internal or external networks) policy. Employees access the Internet from a computer attached to the URS network through the Company's firewall. For security reasons, accessing the Internet directly by modem is prohibited when the computer is connected to the URS network. Internet access requires approval by the user's manager and access requires a password that must be changed every 90 days. On-site computers will also require a password to access the computer and files.

All computers, including laptop computers, desktop workstations, and servers, that are connected to the URS internal network by any method must be continually executing approved malicious code scanning software. The software must be configured to update pattern files or virus signatures on a regular basis. Electronic files transmitted through e-mail are scanned for viruses and worms prior to delivery to the electronic mailbox. On-site personnel will have access through the Internet to the office e-mail. Passwords (separate from the one required to access the URS network) are required to access the e-mail system.

Security procedures similar to those described above for the URS office will be utilized at the site. Computers located at the site will be equipped with Virtual Private Network (VPN) Client, which allows remote users with an internet connection to securely access the URS Network using their Lotus Notes user name and internet password.

Electronic files are archived monthly and daily. Monthly all electronic files stored on the office server are backed up. Daily, an incremental backup of files that have been modified, is produced. Backup media are stored in the office in a limited access room. On-site, electronic files will be backed up weekly to compact disks (CDs) and the CDs will be stored in the office. In the event of a major storm, such as a hurricane or tropical storm, data will be backed up prior to closing the project trailer. The backups will be transferred to the office, and if possible, computers and other electronic equipment will also be removed from the project trailer and transferred to the office.

6.0 REFERENCES

U.S. Environmental Protection Agency (USEPA). 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA. (USEPA/540/G-89/004). October 1988.

U.S. Environmental Protection Agency (USEPA). 2003. Statement of Work for Remedial Investigation (RI) and Feasibility Study (FS) Malone Service Company Superfund Site.

TABLES

Table 1 Data Management Process

Task	Description	Owner
Preliminary Sampling Preparation	Schedule Weekly Field Activities based on FSP using StationIDs	Project Manager/Field Investigation Manager
	Assign SampleIDs	Database Management Assistant
	Order bottles/preservatives from laboratory 48 hours prior to sampling	Sample Tracking Coordinator
	Enter scheduled samples into database using StationIDs and SampleIDs	Database Management Assistant
Sample Kit Assembly	Communicate SampleIDs for samples to be collected during the next day to site	Database Management Assistant
	Print labels, sample collection report, and C-O-C for scheduled samples	Sample Tracking Coordinator
	Assemble bottles/preservatives for sampling teams	Sample Tracking Coordinator
Sample Collection/Field Measurements	Assign sampling duties to sampling crews	Field Investigation Manager
	Sequence the collection and analysis of the QA/QC samples	Field Investigation Manager
	Pick up sampling kits and verify contents against sampling assignment	Sample crews
	Record field data in log book/ boring logs	Sample Crews/Field Geologist
	Collect samples and write date/time/sampler/comments/depth on sample labels and sample collection reports	Sample Crews
	If scheduled samples will not be collected, record reason on sample collection report and mark sample labels as “delayed” or “eliminated”.	Sample Crews
	Transfer samples, unused sample labels, and sample collection reports to Sample Tracking Coordinator	Sample Crews
	Complete boring logs	Field Geologist
	Deliver boring logs to Project Geologist for approval and conversion to database format	Field Geologist
	Enter boring logs into database	Database Management Assistant
	Collect survey data and deliver to Project Geologist in electronic spreadsheet	Survey Team

Table 1 Data Management Process

Task	Description	Owner
Sample Collection/Field Measurements	Verify survey data	Project Geologist
	Enter survey data into database	Database Management Assistant
	Enter date/time/sampler/comments/depth into database	Database Management Assistant
	File field logs, boring logs, survey data in project files	Database Management Assistant
Shipping	Arrange for laboratory pickup	Sample Tracking Coordinator
	Pack coolers with samples and ice	
	Collect C-O-Cs and compare against samples; fix discrepancies and sign C-O-C	
	Fax (or electronically transmit) complete C-O-Cs to laboratory	
	Relinquish C-O-C to laboratory representative at sample pickup	
	File copy of signed C-O-C in project files	
	Deliver “delayed” and “eliminated” sample labels and sample collection report to Field Investigation Manager	
Analytical Measurements	Notify Project Chemist of inconsistencies between C-O-C and submitted samples	Laboratory
	Notify Project Chemist if sample holding times exceeded	Laboratory
	Notify Project Chemist if laboratory problems will necessitate resampling (rejected data)	Laboratory
	Deliver electronic and hard copy analytical reports to Database Management Assistant	Laboratory
	Verify 10% of analytical data for agreement between electronic copy and hard copy	Database Management Assistant
	Notify Project Chemist of inconsistencies; otherwise log in batch as “received”	Database Management Assistant
Data Validation	Load electronic data into the temporary database after resolving inconsistencies between electronic and hard copy.	Database Management Assistant
	Send hard copy analytical report and validation summary to Project Chemist	Database Management Assistant

Table 1 Data Management Process

Task	Description	Owner
Data Validation	Validate data as described in QAPP and annotate hard copy report. Send annotated hard copy of analytical report and list of qualified data to Database Management Assistant	Project Chemist
Final Data	Add validation flags to Temporary Database	Database Management Assistant
	Transfer validated data from Temporary Database to Permanent Database	Database Management Assistant
	File annotated hard copy of analytical reports and archive electronic files	Database Management Assistant
	Submit annotated hard copies to Document Control for scanning and off-site storage	Database Management Assistant
Reporting	Summarize analytical data and sample status for Monthly Progress Reports and Analytical Data Summaries	Project Database Manager
	Generate data reports, electronic data files and data summaries as requested by Project Manager	Project Database Manager

Table 2 Team Member Responsibilities

Personnel	Task	Description
Database Management Assistant	Analytical Measurements	Verify 10% of analytical data for agreement between electronic copy and hard copy
		Notify Project Chemist of inconsistencies; otherwise log in batch as "received"
	Data Validation	Load electronic data into the database after resolving inconsistencies between electronic and hard copy.
		Send hard copy analytical report and validation summary to Project Chemist
	Final Data	Create Permanent Database
		File annotated hard copy of analytical repots and archive electronic files
		Submit annotated hard copies to Document Control for scanning and off-site storage
	Preliminary Sampling Preparation	Assign SampleIDs
		Enter scheduled samples into database using StationIDs and SampleIDs
	Sample Collection/Field Measurements	Enter date/time/sampler/comments/depth into database
		File field logs, boring logs, survey data in project files
		Enter boring logs into database
		Enter survey data into database
	Sample Kit Assembly	Communicate SampleIDs for samples to be collected during the next day to site
Field Geologist	Sample Collection/Field Measurements	Complete boring logs
		Deliver boring logs to Project Geologist for approval and conversion to database format
Field Investigation Manager (Johnny Kennedy)	Sample Collection/Field Measurements	Assign sampling duties to sampling crews
		Sequence the collection and analysis of the QA/QC samples
		Collect the vertical elevations and horizontal coordinate information; submit in an electronic format

Table 2 Team Member Responsibilities

Personnel	Task	Description
Laboratory	Analytical Measurements	Notify Project Chemist of inconsistencies between C-O-C and submitted samples
		Notify Project Chemist if sample holding times exceeded
		Notify Project Chemist if laboratory problems will necessitate resampling (rejected data)
		Deliver electronic and hard copy analytical reports to Database Management Assistant
Project Chemist (Brenda Basile)	Data Validation	Validate data as described in QAPP and notate hard copy report.
		Send annotated hard copy of analytical report and list of qualified data to Database Management Assistant
Project Database Manager (Pete Conwell)	Reporting	Summarize analytical data and sample status for Monthly Progress Reports and Analytical Data Summaries
		Generate data reports, electronic data files and data summaries as requested by Project Manager
Project Geologist	Sample Collection/Field Measurements	Verify survey data
Project Manager/Field Investigation Manager (Dave Ramsden/Johnny Kennedy)	Preliminary Sampling Preparation	Schedule Weekly Field Activities based on FSP using StationIDs
Project Manager (Dave Ramsden)	Recordkeeping	Complete and update the Project Central. Prepare Document Retention Log
Sample Crews	Sample Collection/Field Measurements	Pick up sampling kits and verify contents against sampling assignment
		Collect samples and write date/time/sampler/comments/depth on sample labels and sample collection reports

Table 2 Team Member Responsibilities

Personnel	Task	Description
Sample Crews	Sample Collection/Field Measurements	If scheduled samples will not be collected, record reason on sample collection report and mark sample labels as “delayed” or “eliminated”.
		Transfer samples, unused sample labels, and Sample Collection Forms to Sample Tracking Coordinator
		Record field data in log book/ boring logs
Sample Tracking Coordinator	Preliminary Sampling Preparation	Order bottles/preservatives from laboratory 48 hours prior to sampling
	Sample Kit Assembly	Print labels, sample collection report and C-O-C for scheduled samples
		Assemble bottles/preservatives for sampling teams
	Shipping	Arrange for laboratory pickup
		Pack coolers with samples and ice
		Collect C-O-C forms and compare against samples; fix discrepancies and sign C-O-C
		Fax (or electronically transmit) complete C-O-Cs to laboratory
		Relinquish C-O-C to laboratory representative at sample pickup
		File copy of signed C-O-C in project files
		Deliver “delayed” and “eliminated” sample labels and sample collection report to Field Investigation Manager
Survey Team	Sample Collection/Field Measurements	Collect survey data and deliver to Project Geologist in electronic spreadsheet

Table 3 Sample Data Format

Column headings	Position/ Format	Required/Comments
sys_sample_code	1 Text40	required
sample_name	2 Text30	required
sample_matrix_code	3 Text10	required, e.g., soil or water
sample_type_code	4 Text20	required, e.g., normal, trip blank, equipment blank, field duplicate
parent_sample_code	5 Text40	Required, if applicable, e.g., for field duplicate
sample_delivery_group	6 Text10	required, i.e. Work order# or lab group #
sample_date	7 Date	required
sample_time	8 Time	required
sys_loc_code	9 Text20	required
start_depth	10 Double	required
end_depth	11 Double	required
sampler	12 Text30	required
sampling_company_code	13 Text10	required
composite_yn	14 Text1	required
sample_receipt_date	15 Date	required
sample_receipt_time	16 Time	required

URS Standard EDD Format, Rev 0 – December 19, 2004

Electronic data deliverables must be stored in a comma separated variable (CSV) file or an Excel (xls) file using the following standard format. Maximum length of the field is listed under “position/format” column. If the information is less than the maximum length, do not pad the record with spaces. If EDD is a csv file, each record must be terminated with a carriage return and no final comma. The file can be produced using any software with the capability to create ASCII files. Date is reported as MM/DD/YY or MM/DD/YYYY (month/day/year) and time as HH:MM (hour:minute). Time uses a 24 hour clock, thus 3:30 p.m. will be reported as 15:30. Lab quality control data, such as LCS, method blanks, MS/MSDs, and surrogate data, should not be included.

Table 4 Laboratory Electronic Data Deliverable Format

Column headings	Position/ Format	Required/Comments
project_name	1 Text20	required
sample_id	2 Text40	required as written on C-O-C form
sample_date	3 Date	required
sample_time	4 Time	required
lab_name	5 Text10	required, e.g E-lab (keep less than 10 characters)
lab_sample_id	6 Text20	required, internal lab number
lab_anl_method_name	7 Text35	required
cas_rn	8 Text15	required, use code if no CAS# exists e.g. pH, TOC
parameter_name	9 Text60	required, e.g. Benzene, pH
result_value	10 Text20	required, either the result or blank if not detected above MDL, no extra spaces
lab_qualifiers	11 Text7	required if applicable, flags such as U, J, B
result_unit	12 Text15	required, e.g. mg/Kg (use ug instead of µg)
detect_flag	13 Text2	required, put Y if greater than MDL, N otherwise
sample_quantitation_limit	14 Text20	required, this is the adjusted MDL
dilution_factor	15 Text6	required
sample_matrix_code	16 Text10	required, e.g. soil or water
total_or_dissolved	17 Text1	for groundwater metals analysis, put "T" for unfiltered, "D" for filtered, "N" if not applicable
basis	18 Text10	required (put "dry", "wet" or "na")
analysis_date	19 Date	required
analysis_time	20 Time	required
method_detection_limit	21 Text20	provide if possible, otherwise provide in separate table
lab_prep_method_name	22 Text35	required if applicable
prep_date	23 Date	required if applicable
prep_time	24 Time	required if applicable
unadjusted_MQL	25Text20	required,
client_name	26 Text50	required, e.g. URS
sample_delivery_group	27 Text10	required, i.e. Work order# or lab group #

Table 4 Laboratory Electronic Data Deliverable Format

Column headings	Position/ Format	Required/Comments
sample_receipt_date	28 Date	required
sample_receipt_time	29 Time	required
percent_moisture	30Text5	required if solid sample, number between 0 and 100 with no "%" sign

URS Standard EDD Format for Laboratories, Rev 1 - May 29, 2002

Electronic data deliverables from the laboratory must be stored in a comma separated variable (CSV) file or an Excel (xls) file using the following standard format. Maximum length of the field is listed under “position/format” column. If the information is less than the maximum length, do not pad the record with spaces. If EDD is a csv file, each record must be terminated with a carriage return and no final comma. The file can be produced using any software with the capability to create ASCII files. Date is reported as MM/DD/YY or MM/DD/YYYY (month/day/year) and time as HH:MM (hour:minute). Time uses a 24 hour clock, thus 3:30 p.m. will be reported as 15:30. Lab quality control data, such as LCS, method blanks, MS/MSDs, and surrogate data, should not be included.

Table 5 Survey Data Format

Column headings	Position/ Format	Required/Comments
project_name	1 Text20	required
sys_loc_code	2 Text20	Optional; will be entered by URS
x_coord	3 Double	required
y_coord	4 Double	required
surf_elev	5 Double	required
loc_name	6 Text30	Required, well identification, boring number, etc.
loc_desc	7 Text225	Optional; will be entered by URS;
Loc_type	8 Text20	required, e.g., monitoring well, soil boring, surface soil, etc.
survey_date	9 Date	required
surveyor_name	10 Text30	required

URS Standard EDD Format for Surveyors, Rev 0 – December 19, 2004

Electronic data deliverables from the surveyor must be stored in a comma separated variable (CSV) file or an Excel (xls) file using the following standard format. Maximum length of the field is listed under "position/format" column. If the information is less than the maximum length, do not pad the record with spaces. If EDD is a csv file, each record must be terminated with a carriage return and no final comma. The file can be produced using any software with the capability to create ASCII files. Date is reported as MM/DD/YY or MM/DD/YYYY (month/day/year).

Table 6 Field Parameter Data Format

Column headings	Position/ Format	Required/Comments
sys_code	1 Text20	required
param_code	2 Text10	required, e.g. pH, temperature,
measurement_date	3 Date	required
measurement_time	4 Time	required
param_value	5 Text20	required
param_unit	6 Text15	required, e.g. unit, degrees, etc.
measurement_method	7 Text20	required
param_value_background	8 Text20	required
sampler	12 Text30	required
sampling_company_code	13 Text10	required
instrument_id	14 Text50	required; e.g., Horiba 500
calibration_date	15 Date	required

URS Standard EDD Format, Rev 0 – December 19, 2004

Electronic data deliverables must be stored in a comma separated variable (CSV) file or an Excel (xls) file using the following standard format. Maximum length of the field is listed under “position/format” column. If the information is less than the maximum length, do not pad the record with spaces. If EDD is a csv file, each record must be terminated with a carriage return and no final comma. The file can be produced using any software with the capability to create ASCII files. Date is reported as MM/DD/YY or MM/DD/YYYY (month/day/year) and time as HH:MM (hour:minute). Time uses a 24 hour clock, thus 3:30 p.m. will be reported as 15:30. Lab quality control data, such as LCS, method blanks, MS/MSDs, and surrogate data, should not be included.

Table 7 Lithologic Data Format

Column headings	Position/ Format	Required/Comments
sys_loc_code	1 Text20	required
start_depth	2 Double	required
x_coord	3 Double	required
y_coord	4 Double	required
param_value	5 Text20	required
material_type	6 Text40	required; lithology (soil type)
geo_unit_code_1	7 Text20	required; group symbol code
geo_unit_code_2	8 Text20	required; minor constituents
geo_unit_code_3	9 Text20	optional; seams or partings
geo_unit_code_4	10 Text20	optional; plasticity for cohesive soils
remark_1	11 Text255	required; reserved for PID reading
remark_2	12 Text255	Optional; other observations (e.g., roots, nodules, slickensides, etc.)
odor	13 Text20	required
color	14 Text20	required
observation	15 Text255	optional; variation in description with depth.
consistency	16 Text20	optional; relative density for granular soils; consistency for cohesive soils
grainsize	17 Text20	optional; granular soils only
moisture	18 Text20	Required; dry, moist, wet
custom_field_1	19 Text255	required; drilling type (e.g., CPT, DPT, hollow stem, hand auger, etc.)
custom_field_2	20 Text255	required; sampling type (e.g., direct push liner, grab, split-spoon, shelby tube, etc.)
custom_field_3	21 Text255	required; sample collected (Y/N)
custom_field_4	22 Text255	optional; sample depth
custom_field_5	23 Text255	optional; termination depth

Electronic data deliverables must be stored in a comma separated variable (CSV) file or an Excel (xls) file using the following standard format. Maximum length of the field is listed under “position/format” column. If the information is less than the maximum length, do not pad the record with spaces. If EDD is a csv file, each record must be terminated with a carriage return and no final comma. The file can be produced using any software with the capability to create ASCII files.

Table 8 Investigation Unit, Matrix and Quality Control Sample Codes

Code	Type of Code	Description
A1	Investigation Unit	Unused Area 1
A2	Investigation Unit	Unused Area 2
BA	Investigation Unit	Borrow Area
CA	Investigation Unit	Cemetery Area
DA	Investigation Unit	Drainage Area
WD	Investigation Unit	WDW-138 Area
EI	Investigation Unit	Earthen Impoundment
FW	Investigation Unit	Freshwater Pond
GW	Investigation Unit	Groundwater
LB	Investigation Unit	Laboratory Area
LD	Investigation Unit	Laydown Area
MA	Investigation Unit	Maintenance Area
OA	Investigation Unit	Office Area
EM	Investigation Unit	Estuarine Marsh Area
T8	Investigation Unit	Tank 800 Area
TA	Investigation Unit	Above-ground storage tanks
UA	Investigation Unit	Unit 100 API Separator
US	Investigation Unit	Unit 1200 API Separator
GW	Matrix	Groundwater
SD	Matrix	Sediment
SL	Matrix	Sludge
SS	Matrix	Soil
SU	Matrix	Sump
SW	Matrix	Surface Water
EB	Quality Control Sample	Equipment Blank
FD	Quality Control Sample	Field Duplicate
TB	Quality Control Sample	Trip Blank

FIGURES

Figure 1 Example Sample Label

URS **XYZ Laboratory**

Sample ID: MWGW001-123105
Station ID: MW-GW-01
Date Sampled: 12/31/05
Time Sampled:
Matrix: Water
Preservative/Bottle: 4°C, HCl, 40-ml VOA vial
Analysis SW-846 8260 Volatiles
Signature:

URS **XYZ Laboratory**

Sample ID: EMSD006-010105
Station ID: EM-SD-006
Date Sampled: 01/01/05
Time Sampled:
Matrix: Sediment Depth:
Preservative/Bottle: 4°C, 4-oz SSWM
Analysis SW-846 8270 Semivolatiles
Signature:

URS **XYZ Laboratory**

Sample ID: MWGW001-123105
Station ID: MW-GW-01
Date Sampled: 12/31/05
Time Sampled:
Matrix: Water
Preservative/Bottle: 4°C, liter amber bottle
Analysis SW-846 8270 Semivolatiles
Signature:

URS **XYZ Laboratory**

Sample ID: EMSD006-010105
Station ID: EM-SD-006
Date Sampled: 01/01/05
Time Sampled:
Matrix: Sediment Depth:
Preservative/Bottle: 4°C, 4-oz SSWM
Analysis SW-846 6020 Metals and 7471 Mercury
Signature:

Figure 2 Example Chain-of-Custody

URS

Page		of	

Chain of Custody Form

Customer Information		Project Information		Parameter/Method Request for Analysis	
Send Report To:	David Ramsden	Project No.	25008093	A	Metals (See QAPP)
		Project Name:	Malone Superfund Site	B	Metals (See QAPP) Dissolved
Phone	713-914-6451	Location:	Texas City, Texas	C	Semivolatiles (See QAPP)
Company	URS Corporation	Sample Event:	Remedial Investigation	D	Volatiles (See QAPP)
Address	9801 Westheimer, Suite 500	Fax Results	713-789-8404	E	Herbicides (See QAPP)
City/State/Zip	Houston, Texas 77042	email results	brenda_basile@urscorp.com	F	Pesticides/PCBs (See QAPP)
Turnaround Time:		Reportable Data		G	Low-Level Semivolatiles (See QAPP)
		Reportable/Supporting Data		H	Dioxins/Furans (See QAPP)

No.	Sample Description	Date	Time	Matrix	No. of Bottles	A	B	C	D	E	F	G	H
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													

Sampler(s): Please Print & Sign	Shipment Method:	Airbill No.:	Custody Seal No:	Results Due Date:

Relinquished by:	Date:	Time:	Received by:	Date:	Time:	Preservatives:
Relinquished by:	Date:	Time:	Received by:	Date:	Time:	Notes:
Relinquished by:	Date:	Time:	Received by: (Laboratory)	Date:	Time:	

Note: Any changes must be made in writing once samples and COC Form have been submitted by URS

COC Form.xls

Appendix E – Human Health Risk Assessment Work Plan

TABLE OF CONTENTS

FIGURES

ACRONYM LIST

ABSd	Dermal Absorption Factor
API	American Petroleum Institute
ARARs	Applicable or relevant and appropriate requirements
ATSDR	Agency for Toxic Substances and Disease Registry
AWQC	Ambient Water Quality Criteria
bgs	below ground surface
BLHHRA	Baseline Human Health Risk Assessment
COPC	Constituent of Potential Concern
CSM	Conceptual Site Model
CTE	Central Tendency Exposures
DQO	Data Quality Objectives
EPC	Exposure Point Concentration
FSP	Field Sampling Plan
GCWDA	Gulf Coast Waste Disposal Authority
HEAST	Health Effects Assessment Summary Tables
IRIS	Integrated Risk Information System
MCP	Malone Cooperating Parties
MSC	Malone Service Company
msl	mean sea level
MSSL	Medium-specific Screening Levels
NPL	National Priorities List
PAHs	Polycyclic Aromatic Hydrocarbons
PCL	Protective Concentration Level
PPRTVs	Provisional Peer Reviewed Toxicity Values
PRAER	Preliminary Remedial Alternatives Evaluation Report
PSCR	Preliminary Site Characterization Report
QAPP	Quality Assurance Project Plan

RAGS	Risk Assessment Guidance for Superfund
RfD	Reference Dose
RI/FS	Remedial Investigation/Feasibility Study
RME	Reasonable Maximum Exposure
SAP	Sampling and Analysis Plan
SF	Slope Factor
SVOCs	Semivolatile Organic Compounds
TCEQ	Texas Commission on Environmental Quality
TRRP	Texas Risk Reduction Program
UCL	Upper Confidence Limit
USEPA	United States Environmental Protection Agency
VOCs	Volatile Organic Compounds

1.0 INTRODUCTION

The Malone Service Company, Inc. (MSC) site is located in Texas City, Galveston County, Texas, in an industrial and petrochemical area constructed on the shores of Swan Lake and Galveston Bay (Figure 1). The MSC Superfund Site was proposed to the National Priorities List (NPL) on August 24, 2000, and was placed on the NPL on June 14, 2001. An Administrative Order on Consent (the "Order") for the remedial investigation/feasibility study (RI/FS) was issued by the United States Environmental Protection Agency (USEPA) on September 29, 2003 to the Malone Cooperating Parties (MCP).

1.1 Statement of Work

Included with the Order is a Statement of Work that describes the requirements for the Scoping Phase of the RI/FS. The Scoping Phase includes the following deliverables:

1. Preliminary Site Characterization Report (PSCR), which provides a summary of the known site information (URS 2004a);
2. Preliminary Remedial Alternatives Evaluation Report (PRAER), which selects preliminary remedial alternatives for impacted media at the site (URS 2004b);
3. Remedial Investigation/Feasibility Study Work Plan (RI/FS Work Plan);
4. Sampling and Analysis Plan (SAP) which includes the Field Sampling Plan (FSP) and the Quality Assurance Project Plan (QAPP); and
5. Health and Safety Plan.

The appendices of the RI/FS Work Plan contain various work plans, including this Baseline Human Health Risk Assessment (BLHHRA) Work Plan. The objectives of the BLHHRA Work Plan are to:

- state the problems and potential problems posed by the site,
- identify potentially exposed human receptors, and
- describe the work to be performed in the BLHHRA.

The purpose of this work plan is to describe the technical approach for the BLHHRA as well as the scope of work, assessment methods to be used, and reporting guidelines. The work plan includes a description of the site background and technical approach.

1.2 Work Plan Structure

This BLHHRA Work Plan consists of the following sections:

- Section 1, Introduction, provides a statement of the purpose and structure of the report;
- Section 2, Site Background, discusses the MSC Superfund Site location, history, and

operating units as well as the Conceptual Site Model (CSM), and the Preliminary Remedial Alternatives;

- Section 3, Work Plan Rationale, describes the process for the BLHHRA activities;
- Section 4, Scope of Work for the Baseline Human Health Risk Assessment provides the details for the risk assessment approach for evaluating human health; and
- Section 5, References, provides references for citations in the text.

Relevant information is contained in the following work plans:

1. The RI/FS Work Plan describes the overall focus of the RI/FS, tasks that will be accomplished during the RI/FS, a schedule and project management.
2. The FSP describes the sample locations and sampling protocols for the RI.
3. The QAPP describes the Data Quality Objectives (DQO) process, quality assurance/quality control criteria for the RI/FS, and lists analytes for the RI.

In addition, the PSCR (URS 2004a) and the PRAER (URS 2004b) provide detailed descriptions of the site setting and operations, previous investigations and remedial actions, and the preliminary remedial alternative selection process.

2.0 SITE BACKGROUND AND PHYSICAL SETTING

2.1 Site Background

Prior to planning and implementing the RI/FS, the MCP have provided USEPA with a PSCR (URS 2004a) and a PRAER (URS 2004b). The PSCR:

- collected and analyzed existing data from relevant sources;
- developed a conceptual site model (CSM);
- developed a list of potential state and federal applicable or relevant and appropriate requirements (ARARs) and to-be-considered (TBC) advisories, criteria or guidance; and
- identified data needs.

The PRAER:

- developed remedial action objectives;
- expanded the list of potential state and federal ARARs and TBC advisories, criteria and guidance developed in the PSCR;
- developed and screened alternatives evaluated at similar waste sites;
- developed preliminary remedial alternatives for site media; and
- identified data needs.

Information from the PSCR and the PRAER are summarized below. In order to develop DQOs and to implement the Triad approach, it is necessary for the project team to understand the site, the CSM, the remedial action objectives and the preliminary remedial alternatives. These components, the site background, CSM, the remedial action objectives, the preliminary remedial alternatives, and required data, will be used to develop the DQOs and Dynamic Work Plan. The data gaps identified in the PSCR and the PRAER will be addressed during the RI/FS.

2.1.1 Site Description

This section summarizes the detailed site description presented in the PSCR (URS 2004a). Additional details are presented in Section 2.0 of the RI/FS Work Plan.

The MSC Superfund Site began operating in 1964 as a reclamation plant for waste oils and chemicals. The MSC Superfund Site received a variety of waste products from surrounding industries, including acids and caustics; contaminated residues and solvents; gasoline and crude oil tank bottoms; contaminated earth and water from chemical spill cleanups; general industrial plant wastes; phenolic tars; and waste oils. The liquids injected into the two deep wells included wastewater submitted to the facility for disposal, stormwater from the Sludge Pit, Oil Pit, and separators, and decontamination water collected in the separators. The facility was permitted to dispose of liquid hazardous and nonhazardous waste by means of deep well injection under Injection Well Permit Nos. WDW-73 and WDW-138. The MSC Superfund Site was permitted as a commercial storage, processing and disposal facility authorized to store and process industrial solid waste under Hazardous Waste Permit No. HW-50003 issued in September 1984. The permit authorized the discharge of stormwater runoff.

Operating units at the facility, as shown on Figure 2, included:

1. Earthen Impoundment (Sludge and Oil Pits)
2. Unit 100 American Petroleum Institute (API) Separator
3. Unit 300 tanks
4. Unit 400 tanks and sump
5. Unit 500 tanks
6. Unit 600 boiler
7. Unit 700 (WDW-73) injection well and sump
8. Unit 800 tanks and sump
9. Unit 900 distillation unit
10. Unit 1100 (WDW-138) injection well and sump
11. Unit 1200 API Separator
12. Laboratory and laboratory waste holding tanks

Other non-operating areas at the site included:

1. Decanning unit (operation not documented)
2. Laydown area
3. Freshwater pond
4. Drainage ditches
5. Cemetery
6. Former pits (Backwash pit and oil pits)
7. Undeveloped land

Physical operations ceased in January 1996 and the MSC Superfund Site has been inactive since then. In May 1997, the Texas Commission on Environmental Quality (TCEQ) revoked permits HW-50003, WDW-73 and WDW-138. Waste materials, two API separators, two underground injection wells, roll-off bins, a freshwater pond, sludge impoundment, numerous tanks containing liquid and sludge, chemicals within the facility laboratory, and metal drums inside small buildings were left on the MSC Superfund Site after the plant was closed.

2.1.2 Site Contamination

Impacts to groundwater were discovered at the MSC Superfund Site in 1979. Subsequently, samples collected in January 1986 from the Unit 100 API separator and the earthen impoundment exhibited hazardous waste characteristics with numerous organic and inorganic substances being detected.

Metals, such as antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc, were detected in the majority of samples, and barium was reported as present in the majority of samples analyzed for toxicity characteristic leaching procedure metals (URS 2004a).

The semivolatile organic compounds (SVOCs) detected in the source areas included polycyclic aromatic hydrocarbons (PAHs), phenolic compounds, and phthalate esters. The most frequently detected SVOCs were naphthalene, 2-methylnaphthalene, bis(2-ethylhexyl)phthalate, phenol, phenanthrene, 1,2,4-trichlorobenzene, and acenaphthene. Volatile organic compounds (VOCs) detected in the impoundments, separators and tanks included the aromatic and chlorinated hydrocarbons. The most frequently detected VOCs were total xylenes, ethylbenzene, tetrachloroethene, toluene, 1,1,1-trichloroethane, styrene, trichloroethene, and benzene.

Historical data indicate that groundwater in the vicinity of four wells adjacent to the earthen impoundment and Unit 100 API separator have been impacted by releases from the sources. These wells are located in the paleochannel adjacent to the Sludge Pit. Wells located at the boundary of the facility and wells located around the Unit 1200 API separator have little or no detections of organic compounds. The most comprehensive groundwater sampling event was conducted by Malone Services Company in January 1994. The analytes detected in wells adjacent to the earthen impoundment were still not detected at the facility boundary as late as January 1997, suggesting that impacted groundwater is confined to the paleochannel and has not migrated off-site.

A soil sample was collected during the 1997 Site Screening Inspection at the base of the berm for the earthen impoundment in an area that appeared to have a seep. Two soil samples within the bermed areas of Tanks 339 and 806 were collected during the E&E removal action. The analytical data indicate potential releases to the soils of chlorinated VOCs, polycyclic aromatic hydrocarbons (PAHs), and metals. Methylene chloride and bis(2-ethylhexyl)phthalate were detected in the background sample. The methylene chloride concentration in the field sample was comparable to the background concentration. Benzene, ethylbenzene, toluene, and total xylenes were detected in the field sample adjacent to the earthen impoundment and in the soil samples collected within the bermed areas of Tank 339 and Tank 806. In addition to the volatile aromatic compounds, 1,1-dichloroethene, 1,1,1-trichloroethene, and trichloroethene, were detected in the tank area soils.

Pyrene was the only SVOC detected in the soil from the earthen impoundment area. Concentrations of pesticides detected in the January 1997 SSI were less than the Region 6 Human Health Medium Specific Screening Levels. Phthalate esters and PAHs in the Tank 339 and Tank 806 soil samples exceeded the Region 6 Screening Levels.

The beryllium, chromium, cobalt, copper, lead, nickel, vanadium, zinc and cyanide concentrations in the impoundment samples were comparable to concentrations in the background soil sample. Arsenic, chromium, and lead concentrations in the soils from the January 1997 TCEQ sample event and the August 1999 E&E sample event exceeded the Region 6 Screening Levels.

The CSM conveys what is known about the sources, releases, release mechanisms, contaminant fate and transport, exposure pathways, potential receptors and risks. The CSM is described in detail in Section 3.0 of the RI/FS Work Plan. Data collected during the RI will be used to verify and/or augment the model. The remedial action objectives and the DQOs are developed from the CSM.

2.1.3 Site Setting

The MSC Superfund Site is located on Campbell Bayou Road in Texas City, Galveston County, Texas, on the shores of Swan Lake and Galveston Bay, approximately 1.6 miles east-southeast of the intersection of Loop 197 and State Highway 3 (Figure 1). The MSC Superfund Site encompasses approximately 150 acres. The operating area constituted approximately 75 acres. The MSC Superfund Site is bordered to the east and northeast by Galveston Bay and Swan Lake, which is an embayment of Galveston Bay. The closed Solutia South 20 waste disposal site borders the site on the southwest. Undeveloped land, owned by Scenic Galveston, in the form of marsh and wetlands, which, according to Scenic Galveston literature, is permanently deed recorded as a habitat conservation area, border the southern portions of the MSC Superfund Site. The Gulf Coast Waste Disposal Authority (GCWDA) Campbell Bayou facility is located on the western border of the facility. Northwest of the MSC Superfund Site is a closed Texas City landfill. Scenic Galveston controls access to the MSC Superfund Site through an easement granted to the MCP.

No residents live within one mile of the site. The nearest residential center to the MSC Superfund Site is Bayou Vista, approximately 1.5 miles to the southwest, across Interstate 45, along State Highway 6 (Figure 1). No public water supply or domestic drinking water wells have been identified within a one-mile radius of the MSC Superfund Site. One existing well reportedly drilled at the MSC Superfund Site in a deeper aquifer to supply water for site operations is located on the site near the Unit 700 injection well. GCWDA has one active fresh water supply well on-site. Water from this well is not used for drinking water purposes and is upgradient from the MSC Superfund Site.

The Federal Emergency Management Agency Flood Rate Insurance Map for Texas City, Texas shows the area south of Texas City and east of Highway Loop 197 located within the 100-year flood plain. A flood protection levee surrounds the MSC Superfund Site. The levee was built with an average crest elevation of 5.5 m (18 ft) above mean sea level (msl), and with an average elevation of approximately 3 m (9 ft) above msl around the undeveloped area in the northeast corner of the MSC Superfund Site.

Rainfall runoff discharge and groundwater to surface water discharge from the MSC Superfund Site enter Texas Water Quality Segment 2439 – Lower Galveston Bay. The Lower Galveston Bay segment encompasses approximately 140 square miles. Galveston Bay is a highly productive nursery for oysters, bay shrimp and sport fish. Approximately 7,000,000 pounds of seafood were harvested from the Galveston Bay System.

The shallow subsurface strata beneath the MSC Superfund Site primarily consists of an upper fine sandy to silty clay underlain by a low permeability, stiff red or gray clay to a depth of at least 40 to 45 feet below ground surface (bgs). The major limitation in the subsurface stratigraphy beneath the MSC Superfund Site is the absence of geologic data below 40 to 50 feet bgs. One groundwater supply well was reportedly drilled in 1968 to a depth of 750-ft bgs and screened across a sand interval between 700 and 750 feet bgs. A second well installed in 1975 to a depth of 200-ft bgs and screened across a sand interval between 185 to 198 feet had poor water quality. A thick clay interval more than 100 feet thick reportedly separates the buried paleochannel sand aquifer from the lower sand aquifer. Stratigraphic information from the adjacent GCWDA facility shows a 4-foot thick sand and silt zone at a depth of 88 feet bgs. It is unknown whether this permeable unit is laterally extensive beneath the MSC Superfund Site.

The hydrogeology in the immediate vicinity of the MSC Superfund Site is dominated by a prominent buried paleochannel that meanders southeast from Highway Loop 197 toward Galveston Bay and forms a wide arch beneath the MSC Superfund Site from the southwest to the southeast. A smaller distributary channel bifurcates from the main channel near the center of the MSC Superfund Site and trends to the north-northeast to Swan Lake. The surface expression of the buried paleochannel is evident on early aerial photographs by variations in soil type and vegetation.

2.1.4 Primary Sources and Release Mechanisms

Three primary sources (sources with the largest volume of impacted media) of potential COCs have been identified at the MSC Superfund Site:

1. the earthen impoundment (including both the "Oil Pit" and the "Sludge Pit");
2. the API separators (Units 100 and 1200); and
3. the tanks.

Miscellaneous potential sources (sources which may have released contaminants to soils and groundwater), such as the Closed Backwash Pit, the Laydown area in the northwest corner of the MSC Superfund Site, the distillation unit, ancillary piping, the filters and pumps associated with the injection wells, the laboratory sumps and the proposed decanning area, may have contributed to impacted soil and groundwater, but the current data are inadequate to make a determination.

As shown on Figure 3, potential primary release mechanisms from these sources included:

- Infiltration and percolation from the earthen impoundment, the Closed Backwash Pit, sumps and the slop oil pits;
- Spills from the loading and unloading of wastes at the earthen impoundment, the API

separators and the tanks to the MSC Superfund Site soil;

- Discharges (overtopping) and stormwater runoff from the earthen impoundment;
- Overfilling, spilling and leaking of wastes from process area operations (separators, distillation units, and injection wells) to surface soil and drainage ditches; and
- Leakage from ancillary piping to surface and subsurface soil.

The earthen impoundment was constructed in the paleochannel that transects the MSC Superfund Site. Wastes placed within the earthen impoundment and other potential sources were released to the groundwater through dissolution or sorption onto fine particulate matter. Once dissolved or sorbed, the chemicals would migrate with the groundwater through the preferential flow in the paleochannel.

Potential COCs within the waste liquids and sludge placed in the earthen impoundment, the API separators, and the tanks may have been released to the MSC Superfund Site soil by discharges (overtopping), spills or leaks to surface soil or may have migrated into MSC Superfund Site soil through infiltration or percolation (subsurface soil). Rain and surface-water infiltration through impacted soil leaches the more water-soluble portions of the fluids resulting in the water-miscible fluids mixing with the groundwater and, depending on site characteristics, may migrate laterally.

Potential COCs residing in surface soil (0 - 2 feet), such as in the tank areas may be mobilized and transported by wind erosion, volatilization, or episodic surface runoff. These potential COCs in surface soil may also migrate vertically to subsurface soil by desorption and leaching processes and may potentially enter groundwater.

Potential COCs in the groundwater may migrate by advection and dispersion via groundwater flow, volatilize to soil gas and ultimately disperse into the atmosphere, or become adsorbed to aquifer soils. Advection by means of groundwater flow may redistribute potential COCs to the shallow groundwater environment or transfer them to deeper aquifers. These potential COCs are subject to attenuation by chemical and biological degradation processes. The silt and sand in the vadose zone paleochannel increases the probability of impacted groundwater migration from the source to off-site receptors either in the marsh area between the MSC Superfund Site and Swan Lake or to the east (the closed Solutia South 20 waste disposal site).

2.1.5 Secondary Sources and Release Mechanisms

The primary releases may result in secondary sources: groundwater, on-site surface and subsurface soils and the on-site drainage ditches. Potential secondary release mechanisms from the soils at the MSC Superfund Site include:

- runoff from contaminated on-site soils to on-site surface water and on-site sediment;
- soil leaching to on-site groundwater;
- groundwater migration off-site; and

- discharge to off-site surface water and off-site sediment.

The mechanisms for releases from the sources, such as infiltration, percolation, advection and sorption, as discussed above also apply to the secondary sources.

2.1.6 Media

Based on the information provided in the environmental reports and summarized in the PSCR and PRAER, the following potentially impacted media have been identified:

- on-site and off-site sediments;
- on-site surface and subsurface soils soils;
- on-site surface water; and
- groundwater.

2.1.7 Human Health Exposure Pathways

Potential human health exposure pathways for the MSC Superfund Site include:

- incidental ingestion of surface and subsurface soil;
- incidental ingestion of on-site and off-site sediment;
- incidental ingestion of on-site surface water;
- ingestion of fish;
- dermal contact with surface and subsurface soil;
- dermal contact with on-site and off-site sediment;
- dermal contact with on-site surface water;
- inhalation of volatile emissions from groundwater;
- inhalation of volatile emissions from on-site surface water;
- inhalation of volatile emissions from on-site and off-site sediment; and
- inhalation of volatile emissions from surface and subsurface soil.

The potential for release of VOCs is high where the waste is potentially exposed to the atmosphere, such as in the Sludge Pit, and the Unit 100 and Unit 1200 API separators. Since the predominant wind direction is from the southeast, the population northwest of the MSC Superfund Site would be the potential receptors of air emissions. The Texas City Industrial Complex is northwest of the MSC Superfund Site.

The Unit 100, Unit 700, Unit 900, Unit 1100 and Unit 1200 areas are constructed on curbed concrete pads. The integrity of these concrete pads is unknown; therefore, the potential for releases to soils cannot be eliminated. The Unit 300, Unit 400, and Unit 800 tanks sit on native soil in areas bermed with native clay. The potential for releases to surface soils in these areas would be high. Depending on the subsurface stratigraphy, release potential to subsurface soils in these units would be low in areas constructed over the impermeable native clay, while the release potential to subsurface soils would be high in areas constructed over the paleochannel. Those units, such as the Sludge Pit and the Oil Pit, which are completed in the paleochannel, have a high release potential to soils and to groundwater.

Concentrations of metals, VOCs and SVOCs in the shallow groundwater bearing-unit indicate that groundwater has been impacted by releases from the MSC Superfund Site operations. These releases may have occurred from those units located above or within the paleochannel, such as the Unit 100 API separator and the earthen impoundment (the Sludge Pit and the Oil Pit).

Since the Freshwater Pond was excavated into the paleochannel, variations in the pond elevations correspond to variations in water levels of monitoring wells completed in the paleochannel demonstrating that the Freshwater Pond is hydraulically connected to groundwater. The pond collected stormwater runoff from areas of the facility and potentially may have accumulated contaminants. Contaminated on-site surface soils would drain to the on-site drainage ditches. Discharge/runoff from on-site drainage ditches was (and may currently be) channeled to the Freshwater Pond via the Laydown area or to off-site surface water and sediments through the stormwater discharge. If contaminants have accumulated within the pond, they may be released to groundwater and, depending on whether the hydraulic gradient from the Sludge Pit, Oil Pit and Unit 100 API separator is towards the pond, groundwater contaminants may be released to the pond.

2.1.8 Receptors

Figure 3 summarizes the selection of potential exposure pathways for evaluation in the RI/FS for the MSC Superfund Site. Multiple exposure routes for inhalation, ingestion, and dermal contact exist for each of the pathways listed above and for each of the type of receptors (human and ecological). Swan Lake is not included in the MSC Superfund Site assessment since this area was assessed/remediated as part of the TexTin Operable Unit 4.

The potential for exposure to residential receptors was not evaluated in the CSM. It is likely that restrictions on future development at the site, including restrictions against homes, hospitals, schools and day-care centers, will be placed on the property. No on-site residences exist and the closest off-site residential area (Bayou Vista) is approximately 1.5 miles away. Currently, the MSC Superfund Site is inactive. Activities, such as stormwater disposal and security patrol, occasionally occur on-site.

The site is abutted by the GCWDA Campbell Bayou Facility nonhazardous waste land disposal facility, the closed Solutia South 20 pre-RCRA landfill, and the 1,500-acre Virginia Point Peninsula Preserve, a permanently deed restricted habitat conservation area. Scenic Galveston controls access to the MSC Superfund Site through an easement granted to the MCP.

Possible future site development, either as an industrial facility or as a nature preserve will potentially require the presence of industrial workers, construction workers and/or recreational users. These potential human receptors were included in the CSM.

Potentially complete on-site pathways for human receptors include inhalation of volatile compounds by industrial workers, construction workers or on-site recreational users from the groundwater media . Ingestion and dermal contact exposure pathways are not considered complete for on-site groundwater exposure to human receptors. These exposure pathways are not considered complete since the on-site water well does not provide potable water and is completed approximately 750-ft bgs. In addition, the total dissolved solids data (> 10,000 mg/L) for the shallow groundwater at the MSC Superfund Site and the adjacent closed Solutia South 20 waste disposal site indicate that this water would not be a source of potable water in the future. Drinking water regulations do not recommend the consumption of water with greater than 500 mg/L TDS (40 CFR 143.3). In addition, groundwater with greater than 10,000 mg/L of TDS is not considered an underground source of drinking water (40 CFR 146.3).

Incidental ingestion, inhalation of volatile compounds, and dermal contact to on-site surface soils are considered potentially complete exposure pathways to industrial workers and construction workers. In addition, inhalation of volatile compounds emanating from subsurface soils is a considered potentially complete exposure pathway to industrial workers and construction workers. Incidental ingestion and dermal contact with subsurface soils are considered potentially complete exposure pathways to construction workers.

Incidental ingestion, inhalation and dermal contact to the following on-site media, surface soils, surface water and sediments, are considered potentially complete exposure pathways for on-site recreational users. Inhalation of vapors from subsurface soils is considered a potentially complete exposure pathway to recreational users. The Freshwater Pond is of sufficient size to be attractive for recreational anglers. Swimming, wading, and fishing are possible exposure scenarios for the on-site surface water body for on-site recreational users. Therefore, exposure to constituents in surface water and sediment in the Freshwater Pond may occur through dermal contact, incidental ingestion, inhalation of volatile constituents, and ingestion of fish that may have bioconcentrated/bioaccumulated constituents in surface water and sediments for on-site recreational users. While the earthen impoundment is not attractive to recreational anglers due to a lack of fish due to insufficient water depth to support a fish population of harvestable size, attempts may be made to access the impoundment for fishing. Therefore exposure to constituents in surface water in the earthen impoundment may occur through dermal contact and inhalation of volatile constituents for on-site recreational users.

Off-site recreational users of the marsh area between the hurricane levee and Swan Lake may be exposed to constituents present in the sediments. Sediment in the marsh area may have been affected from stormwater runoff from the site or discharge of affected groundwater into the marsh area. Dermal contact and incidental ingestion may occur when the recreational user is wading in the marsh area. In addition, the off-site recreational user may be exposed to volatile constituents emanating from the sediments and to constituents that bioaccumulate/bioconcentrate by fish ingestion. Off-site surface water in the estuarine marsh is not considered in the BLHHRA because it is tidally influenced and contaminant concentrations in the surface water would not necessarily reflect influences from the MSC Superfund Site.

The fish ingestion exposure pathway for both the on-site and off-site recreational user will be evaluated in the risk assessment by calculating hypothetical fish tissue concentrations from the sediment data. A hypothetical fish tissue concentration will be calculated by taking the reported concentration in the sediment and multiplying by the biota-sediment accumulation factor (BSAF). A BSAF is a specific bioaccumulation factor that is the ratio of lipid-normalized tissue chemical residue to organic carbon normalized sediment chemical concentration. With historical releases, sediment and surface water constituent concentrations will be in equilibrium. Therefore, the BSAF incorporates both sediment and surface water exposure of the fish to constituents and the eventual human ingestion.

2.1.9 Remedial Action Objectives

In order to facilitate the selection of preliminary remedial alternatives, the site has been divided into remedial units. The remedial units were selected based upon the media, the types of contaminants, and the exposure scenario: groundwater, sludge and liquid wastes, on-site surface and subsurface soils, on-site sediments, and off-site sediments. On-site surface water was not considered a remedial unit because remedial action objectives for sediment/sludge will effect a remedy of the surface water. The sludge and liquid wastes remedial unit includes material contained within the primary sources, the earthen impoundment, API separators, tanks, pits, and sumps. Structures were not included in the remedial units since they belong to the property owner. Sludge and liquid wastes remaining within structures such as tanks, sumps, or buildings are included in the sludge and liquid wastes remedial unit.

Remedial action objectives provide medium-specific (or remedial unit specific) goals for protecting human health and the environment. Using the CSM information discussed above, remedial action objectives were developed for each remedial unit. This section summarizes the remedial action objectives pertinent to the BLHHRA.

The human health remedial action objectives for **groundwater** are to:

- mitigate inhalation of carcinogenic and non-carcinogenic contaminants by site workers and recreational users to agreed risk-based cleanup levels; and
- mitigate further migration of the contaminated groundwater that will not naturally attenuate to off-site properties.

The human health remedial action objectives for **sludge and liquid wastes** are to:

- mitigate direct contact/inhalation of carcinogenic and non-carcinogenic contaminants to agreed risk-based cleanup levels by on-site recreational users;
- mitigate the release of carcinogenic and non-carcinogenic contaminants to agreed risk-based

cleanup levels from sludge and liquid wastes to surface soils and sediments; and

- mitigate migration of carcinogenic and non-carcinogenic contaminants from sludges and liquid wastes to groundwater to agreed risk-based cleanup levels for inhalation from groundwater contaminants by site workers and on-site recreational users.

The human health remedial action objectives for **on-site soils and sediments** (remedial action objectives for sediment are assumed to effect remedy of surface water as well) are to:

- mitigate ingestion/direct contact/inhalation by site workers and on-site recreational users of carcinogenic and non-carcinogenic contaminants from surface soils to agreed risk-based cleanup levels;
- mitigate inhalation by site workers and on-site recreational users of carcinogenic and non-carcinogenic contaminants from subsurface soils to agreed risk-based cleanup levels;
- mitigate direct contact/ingestion by site construction workers to carcinogenic and non-carcinogenic contaminants in subsurface soil;
- mitigate ingestion/direct contact/inhalation by on-site recreational users of carcinogenic and non-carcinogenic contaminants from sediments to agreed risk-based cleanup levels;
- mitigate ingestion (fish) by recreational users of carcinogenic and non-carcinogenic contaminants from sediments to agreed risk-based cleanup levels; and
- mitigate migration of contaminants to groundwater from on-site soils and sediments to agreed risk-based cleanup levels for the prevention of inhalation of contaminants by site workers and recreational users.

The human health remedial action objective for on-site surface water is to:

- restore surface water to agreed risk-based cleanup levels protective of on-site recreational users (assumed to be the maximally exposed individual thus being protective of all human receptors) from carcinogenic and non-carcinogenic contaminants in the Freshwater Pond and the Earthen Impoundment.

The human health remedial action objectives for the **off-site sediments** in the marsh area between the MSC Superfund Site and Swan Lake are to:

- mitigate ingestion/direct contact/inhalation of carcinogenic and non-carcinogenic contaminants from sediment by off-site recreational users to agreed risk-based cleanup levels;
- mitigate ingestion of fish by off-site recreational users of carcinogenic and non-carcinogenic contaminants to agreed risk-based cleanup levels; and
- mitigate migration of contaminants to groundwater from off-site sediments to agreed risk-based cleanup levels for the prevention of inhalation of contaminants by off-site recreational users.

2.1.10 Remedial Alternatives

The preliminary remedial alternatives selected in the PRAER were based on data and experience from the MSC Superfund Site and from other Superfund or related waste sites with similar settings, histories, and contaminants. This information was used to eliminate ineffective remedial alternatives and to evaluate effective remedial alternatives. The development of a preliminary remedial alternatives for affected media at the MSC Superfund Site did not eliminate the evaluation of other remedial alternatives during the FS if data developed during the RI indicate that other technologies may be more suitable for the site contaminants.

The site was divided into remedial units (portions of the site with similar operational histories and potentially impacted media) and preliminary remedial alternatives were developed for these remedial units. The preliminary remedial alternative for the **sludge, waste materials, and heavily impacted soils** contained in the earthen impoundment, Unit 100 API Separator, Unit 1200 API Separator, and the Unit 800 tank area has several components:

1. bioremediating the sludge, waste and soils to reduce volume and toxicity;
2. injecting the treated water into the underground injection well;
3. solidifying and stabilizing the residuals in the sludge pit;
4. capping the solidified/stabilized residuals; and
5. maintaining the existing hurricane levee and controlled stormwater drainage system.

Several alternatives for **surface and subsurface soils**, such as those that might exist in the Laydown area, the undeveloped areas, and the Tank 100 through 700 areas, impacted above risk levels were proposed:

1. in-situ (landfarm) treatment followed by covering the treated soils with a soil cap; or
2. excavating and incorporating the soils into the sludge and waste bioremediation system; or
3. excavating and consolidating the soils with the solidified/stabilized residuals from the sludge and waste treatment.

Treatment alternatives for potentially contaminated **sediments** containing organic compounds exceeding risk-based criteria were developed in the PRAER:

1. no action for on-site sediments.
2. natural siltation for off-site sediments in the marsh area east of the site between the flood protection levee and Swan Lake.

The preliminary remedial alternative for **groundwater** has three components:

1. installing a slurry wall in the paleochannels on either side of the Sludge Pit;
2. maintaining an inward gradient by pumping the groundwater inside the slurry wall and

injecting the treated water into underground injection well; and

3. monitoring natural attenuation of groundwater outside the slurry wall.

The appropriate remedy(ies) for these areas will be determined from the RI data based on the volume of material requiring treatment and the concentrations of the contaminants.

Identify Principal Study Questions

The MSC Superfund Site was divided into investigation units using information presented in the PSCR and PRAER. The operating units described in the PSCR and the remedial units described in the PRAER were used to determine remedial investigation units using the following criteria:

- operating history,
- aerial photographs,
- obvious impact from visual observations,
- risk before implementing any remedy, and
- risk after implementing a preliminary remedial alternative.

As shown in the three-dimensional CSM (Figure 4), the four site investigation units are:

1. Non-operating units
2. Operating units
3. Sludge and waste units
4. Ecological units

Non-operating units that are anticipated to have minimal impacted soils are shown in green. Operating units, which may have subsurface contamination from spills and materials handling, are shown in orange. Sludge and waste units, the earthen impoundment and API separators, are shown in red. The ecological investigation unit, including the Freshwater Pond, the drainage ditches, and the marsh area between the hurricane levee and Swan Lake, are shown in blue.

The non-operating investigation units contains the following areas:

1. Unused areas 1 and 2
2. Office area
3. Laydown area
4. Cemetery area, and
5. Borrow area.

The operating investigation unit areas include:

1. the laboratory area,
2. the WDW-138 deep well area,
3. the maintenance area (including the 300 through 700 units and the 900 unit), and
4. the 800 Tank area.

The principal study questions for human health exposure may be stated as:

1. Do concentrations of COCs in on-site surface soils in non-operating units exceed site-specific risk-based criteria established for human receptors?
2. Do concentrations of COCs in on-site surface soils in operating units exceed site-specific risk-based criteria established for human receptors?
3. Do concentrations of COCs in on-site subsurface soils in operating units exceed site-specific risk-based criteria established for human receptors?
4. Do concentrations of COCs in on-site surface water exceed site-specific risk-based criteria established for human receptors?
5. Do concentrations of COCs in on-site or off-site sediments exceed site-specific risk-based criteria established for human receptors?
6. Do concentrations of COCs in groundwater exceed site-specific risk-based criteria established for human receptors?

Define Alternative Actions

The alternative actions that could result from the resolution of the principal study questions are to recommend that portions of the site (i) require no further evaluation or selection of a remedy; or (ii) warrant additional assessment or selection of a remedy. These alternative actions apply to the principal study questions for the BLHHRA.

Develop Decision Statements

The principal study question and the alternative actions are combined into the following decision statements for the BLHHRA.

1. Determine whether COC concentrations in on-site surface soils in non-operating units exceed site-specific risk-based human health criteria and warrant additional investigations or a response action, or whether the COC concentrations are equal to or less than site-specific risk-based human health criteria and the on-site surface soils in operating units require No Further Action.
2. Determine whether COC concentrations in on-site surface water exceed site-specific risk-based human health criteria and warrant additional investigation or a response action, or whether the COC concentrations are equal to or less than site-specific risk-based human health criteria and the

surface water require No Further Action.

3. Determine whether COC concentrations in on-site and off-site sediments exceed site-specific risk-based human health criteria and warrant additional investigations or a response action, or whether the COC concentrations are equal to or less than site-specific risk-based human health criteria and the sediments require No Further Action.
4. Determine whether COC concentrations in on-site groundwater exceed site-specific risk-based human health criteria and warrant additional investigation or a response action, or whether the COC concentrations are equal to or less than site-specific risk-based human health criteria and the surface water require No Further Action.

3.0 WORK PLAN RATIONALE

Risk assessments are generally performed to determine whether current conditions at a site pose unacceptable risk to human health and whether the exposure conditions assumed under a future land use scenario might be associated with unacceptable risk. The results are typically used to: 1) support the conclusion of no further remedial action at a site; 2) focus corrective action at sites (i.e., prioritize remedial efforts); and 3) develop site-specific cleanup levels for media of concern.

The primary objectives (goals) of the risk assessment are to:

- evaluate potential risk to human health considering site-specific conditions;
- identify remedial units that will require no further action;
- identify remedial units that will require corrective measure(s) and prioritize corrective action needs at units requiring remedial action; and
- develop site-specific clean up goals, where appropriate.

4.0 SCOPE OF WORK FOR BASELINE HUMAN HEALTH RISK ASSESSMENT

Potentially exposed receptors to be evaluated in the BLHHRA have been narrowed to those appropriate for the plausible future land use, either as an industrial facility, a recreational area or a wildlife preserve. Therefore, potentially exposed current and future receptors include industrial workers and construction workers. Assuming future use of the site as a wildlife preserve, potentially exposed receptors include on-site recreational users for activities such as bird watching and fishing and/or swimming in the Freshwater Pond and off-site recreational users involved in activities such as wading or fishing in the estuarine marsh between the site boundary and Swan Lake. Thus, the elements of this work plan include consideration only of this focused group of receptors.

The BLHHRA will include an initial screening-level assessment that will be performed primarily to identify constituents of potential concern (COPC) and a more comprehensive assessment of exposure potential and accompanying risk for constituents that exceed screening criteria. Another purpose of the screening-level assessment is to identify investigation units on the site that are candidates for no further action to prioritize investigation units for a focused approach for the BLHHRA. The approach to the screening assessment is described in Section 4.1.

The constituents and investigation units that exceed screening criteria will be subject to further evaluation as discussed in Sections 4.2 through 4.4. A BLHHRA will be completed for investigation units identified as requiring further evaluation in the COPC identification step. The risk evaluation will be conducted in accordance with procedures outlined in the USEPA's *Risk Assessment Guidance for Superfund Parts A and B* [RAGS] (USEPA 1989 and 1991a) and will be performed assuming the absence of any controls or remedial actions to mitigate affected media. Information described in Sections 4.2, 4.3, and 4.4 will be presented in the BLHHRA in the format prescribed in RAGS D (USEPA 1998).

The BLHHRA will consist of the following five components:

- selection of COPCs;
- exposure assessment;
- toxicity assessment;
- risk characterization; and
- uncertainty analysis.

4.1 Selection of Constituents of Potential Concern

This section describes the approach to the selection of COPCs, including data evaluation and data screening.

4.1.1 Data Evaluation and Screening

This section will summarize the analytical data collected for the media of concern by remedial unit and exposure area (as applicable), and will present the process of how constituents will be identified as COPCs for further evaluation in the risk assessment. As further discussed in Section 4.2, MCP will consider an exposure area concept. The evaluation of multiple investigation units as a single exposure area will be conducted in the risk assessment if it can be reasonably supported that the data collected across the multiple units are homogeneous in character. Conversely, segregation of one or more discrete exposure units within a single remedial unit might be justified if the results of sampling of that unit indicate that a high degree of heterogeneity exists in the data set (e.g. “hot spots” in one or more locations within a remedial unit). Data collected from across the various units will be evaluated to determine which particular pattern exists.

As discussed in RAGS Part D (USEPA 1998), the data summaries will include the number of analyses, frequency of detection, minimum, maximum, and mean concentrations. Statistical methods included in the ProUCL data analysis program will be used to determine representative constituent concentrations in soil (USEPA 2004a). Assuming that adequate numbers of sediment samples are collected from the Freshwater Pond and the marsh area between the levee and Swan Lake, sediment means may also be calculated. If sufficient data is not available to allow for a statistical representation of the mean, then the maximum detected concentration will be used to assess risk. Since the primary exposure pathway for groundwater underlying the site is inhalation of vapors emanating from groundwater, statistical representation of volatile constituent concentrations in groundwater is appropriate to characterize vapor emissions over a finite source area (i.e., the area of the groundwater plume that contains volatile constituents).

Data quality evaluations will be performed in conformity with the procedures specified in the QAPP prepared for this site. There also will be a data usability analysis of data to be used in the BLHHRA. The usability evaluation will be conducted following USEPA guidance in RAGS (USEPA 1989), *Guidance for Data Usability in Risk Assessment* (Part A) Final (USEPA 1992), and other relevant sources. The usability criteria identified in the 1992 guidance document will be used in the evaluation of the suitability of data for use in quantitative risk estimation. Note that usability factors were also considered in the design of the proposed sampling and analysis, as recommended in the guidance (e.g., analytical methods/detection limits, representative goals, precision as indicated by quality control samples). Therefore, the risk assessment will include the results of the data quality evaluation, including conclusions regarding data usability for purposes of quantitative risk assessment.

The detailed data quality evaluation will be conducted for newly collected data. Due to the length of time that has elapsed since the last sampling event(s) were conducted, historical data will not be used in the BLHHRA. Therefore, the groundwater risk evaluation will use groundwater data collected during the RI to assess the single human health pathway of inhalation in an outdoor (i.e., ambient) setting of volatile emissions from groundwater. As per guidance (USEPA 1991a), volatile constituents include those constituents having a Henry's Law constant greater than 1E-05 atm-m^3/mol and a molecular weight of less than 200 g/mol.

A data screening process using risk-based criteria applicable to industrial exposure, which is the exposure scenario that will result in the greatest degree of risk to human health over a lifetime, will be performed to identify constituents that should be retained for further evaluation and those that may be excluded from further evaluation. The industrial screening criteria are a conservative approach to screening for the recreational visitor due to the longer exposure duration and exposure frequency. Data screening is considered applicable in order to differentiate between constituents that are reasonably anticipated to be associated with site activities and those that are not, and to focus the assessment on those constituents that are likely to have the greatest potential impact on the overall risk of the site. The results of the data-screening step will be used to identify COPCs for each medium evaluated, each investigation unit evaluated, and each exposure area determined to be present as a result of the data homogeneity/heterogeneity analysis.

4.1.2 Comparison to Background Concentrations

A statistical background comparison will be completed for naturally occurring and anthropogenic constituents in the media sampled if suitable background data are available for soil, groundwater, surface water, and sediment. If the data allow, a formal statistical approach (e.g., Wilcoxon Rank Sum test) will be used for background comparisons. For the soil medium only, if there are no suitable background data for the site, Texas-specific median background values included in the TCEQ Texas Risk Reduction Program (TCEQ 1999) will be used. A background screen will not be used to exclude chemicals from the risk assessment, however, the results of the background comparison will be discussed in the Uncertainty Analysis portion of the BLHHRA.

USEPA guidance and relevant scientific literature will be used to select statistical methods appropriate to the site-specific data sets. Relevant USEPA guidance includes, but is not limited to *Superfund Technical Guidance, No. RA-03: Contaminants of Concern* (USEPA 1994)*, Determination Of Background Concentrations Of Inorganics In Soils And Sediments At Hazardous Waste Sites (*USEPA 1995) and *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites (*USEPA 2002a*)*. The USEPA 1995 and 2002 publications identify desirable features of a background data set. The existing data set will be reviewed relative to recommendations in the publications, and the risk assessment will include a comment in the data evaluation section regarding the results of this review. The USEPA 1994 and 2002 guidance contain recommendations for distributional tests (statistical tests used to determine whether central tendencies of two groups of data are similar) for background evaluation in risk analysis. Based upon the results of statistical comparison, constituents detected at concentrations that are within background range will be excluded from further quantitative risk evaluation.

4.1.3 Frequency of Detection

If more than 20 samples are collected in an exposure group and the detection frequency for a constituent is less than 5%, that constituent will not be selected as a human health COPC.

4.1.4 Comparison to Industrial Risk-Based Screening Levels

Screening will be conducted for constituents detected in soil, sediment, surface water, and groundwater. , Constituents present at concentrations exceeding screening criteria are retained for further analysis in the baseline risk assessment

For each constituent detected in soil and groundwater, *industrial* risk-based screening levels will be used to identify which constituents require more detailed evaluation under more site-appropriate exposure scenarios (based on the results of the conceptual exposure model for an exposure area). This is a common data reduction step used in quantitative risk assessment that allows the risk evaluation to focus on those constituents that are likely to have the greatest potential impact on the overall risk. USEPA Region 6 industrial outdoor worker medium-specific screening levels; MSSLs (USEPA, 2004b), will be used for the screening of the soil medium. This approach is conservative because the industrial worker exposure frequency is 250 days as compared to the smaller exposure frequency for the recreational user and construction worker.

The screening-level BLHHRA also may be used to identify which, if any, investigation units may be eliminated from further evaluation based on a comparison of site soil data to conservative risk-based soil screening levels (i.e., the MSSLs).

Risk-based screening criteria (i.e., MSSLs) published by USEPA Region 6 do not include values for inhalation of volatile emissions in outdoor air from COPCs that might be present in groundwater underlying the site. However, the TCEQ Texas Risk Reduction Program (TRRP) has published protective concentration levels (PCLs) for the inhalation of volatile emissions from groundwater (TCEQ 1999). Thus, the TCEQ groundwater to air ($^{Air}GW_{Inh\text{-}v}$) PCLs will be used as a comparison to groundwater site data in order to determine which investigation units require further site-specific risk evaluation and which investigation units may be eliminated from further evaluation. It is noted that the TCEQ PCLs for carcinogenic constituents are based on one-in-one hundred thousand cancer risk ($1x10^{-5}$) while the Region 6 MSSLs are based on one-in-one million cancer risk ($1x10^{-6}$). To provide consistency, the TCEQ values reflective of carcinogenic risk will be reduced by an order of magnitude prior to use in the screening process.

The TCEQ TRRP PCLs for ingestion, inhalation, and dermal contact exposure ($^{Tot}Soil_{Comb}$) industrial worker will be used as a comparison to surface soil data in order to determine units that require further site-specific risk evaluation and which units may be eliminated from further evaluation. The $^{Tot}Soil_{Comb}$ PCLs include the three exposure pathways (ingestion, inhalation, dermal contact) and after adjustment from the on one-in-one hundred thousand cancer risk ($1x10^{-5}$) to the one-in-one million cancer risk ($1x10^{-6}$) provide a conservative estimate of risk. The industrial outdoor worker direct contact MSSLs will be used as the screening value for soils in the one to two-foot depth interval. The goal is to identify constituents for which risk calculations will be performed for direct contact exposures.

Region 6 does not provide MSSLs for the soil medium that address protection of groundwater from soil leachate (with subsequent inhalation of volatile emissions emanating from groundwater), therefore the TCEQ soil leachate to groundwater PCLs ($^{Air}GW\text{-}Soil_{Inh\text{-}v}$)will be used in order to determine which investigation units require further site-specific risk evaluation and which investigation units may be eliminated from further evaluation. As discussed above, the TCEQ PCLs ($1x10^{-5}$) will be reduced by an order of magnitude prior to use in the screening process to provide consistency with Region 6 MSSLs ($1x10^{-6}$).

Region 6 does not provide MSSLs for surface water and sediment. Region 6 MSSLs for tap water will be used to screen the surface water data. While these levels are very conservative for recreational user exposure, they provide an initial screen for eliminating chemicals that do not contribute to the overall risk. TCEQ provides human health sediment PCLs (RG-366/TRRP-24 Determining PCLs for Surface Water and Sediment) (TCEQ 2002). After adjustment from the on one-in-one hundred thousand cancer risk ($1x10^{-5}$) to the one-in-one million cancer risk ($1x10^{-6}$), these PCLs will provide a conservative estimate of risk.

Investigation units recommended for No Further Action because constituent concentrations were less than USEPA Region 6 and TCEQ industrial screening levels will not be addressed in the BLHHRA beyond the COPC identification step. Only investigation units that are screened for further assessment will be evaluated in a site-specific risk assessment. Figure 2 presents the locations of investigation units that will be assessed for COPC identification and if needed, further assessment in the BLHHRA.

4.2 Exposure Assessment

The objective of the exposure assessment is to estimate the nature and magnitude of exposures to COPCs present in media of concern. The exposure assessment identifies potential receptors and exposure pathways. Exposure scenarios, with associated intake assumptions, are identified for pathways considered complete. A complete exposure pathway requires four necessary elements:

- A source and a mechanism for chemical releases to the environment (primary and secondary sources and release mechanisms).
- An environmental transport medium for the released chemical.
- A point of human contact with the medium.
- A human uptake route (ingestion, inhalation, or dermal contact) at the point of exposure.

The magnitude of exposure is then calculated for those complete pathways.

To the extent the analytical data indicate to be appropriate, the MCP will assess all data collected over the entire site, which will allow the determination of plausible exposure areas for human receptors likely to occupy the site in the future. The USEPA has no defined size for exposure areas used by industrial receptors or recreational receptors, so an alternative approach to determining appropriate exposure areas for these receptors is to determine whether elevated constituent concentrations in soil, sediment, surface water, and groundwater are grouped/clustered into discrete areas. For example, if investigation units adjacent to one another reasonably form a single exposure area, the data for adjacent units may be combined to estimate risk. Alternatively, if a single remedial unit does not form a single exposure area, the data may be split into smaller exposure areas containing discrete areas of elevated concentrations in order to estimate risk. Another factor that will be considered in this regard is whether workers are reasonably likely to spend time working in or near multiple units that are within the same geographical location.

A *preliminary exposure assessment* was performed using information available to date and information obtained from discussions with USEPA regarding plausible receptors according to future land use. As a result, a preliminary CSM has been prepared, listing the potential receptors and exposure pathways MSC will consider in the BLHHRA (Figures 3). The preliminary CSM therefore identifies the broadest list of pathways that are potentially complete. For a given exposure area, the final pathways/scenarios to be quantitatively evaluated will be identified through further exposure assessment after collection of the data as proposed in this work plan. The *further exposure assessment* will consider whether all elements of a complete pathway are present: release, transport mechanism/affected media, receptor, and exposure route. The CSM is therefore subject to refinement based upon (a) the complete body of data collected to support the risk assessment, and (b) exposure area. The following subsections provide supporting discussion of the preliminary CSM prepared for the site.

4.2.1 Characterization of the Exposure Setting

The exposure setting describes the land use on-site and within the immediate surrounding area as they pertain to potential human exposure pathways. The description of the exposure setting includes a discussion of the physical setting and site/regional environmental conditions (e.g., groundwater and surface water resources) that may influence exposure on-site or off-site. These data and information are used to identify receptors and pathways. Section 2.0 of this Work Plan describes the exposure setting and detailed information is available in the PSCR (URS 2004a) and PRAER (URS 2004b)

4.2.2 Identification of Receptors, Exposure Pathways and Routes

Based upon the exposure setting, potential receptors are identified as follows. A human health CSM is provided as Figure 3. Under current conditions, industrial workers (security personnel at present), construction workers, and recreational users of the adjacent off-site estuarine marsh are potential receptor populations. Included in the future exposure evaluation is an on-site recreational user of the site, such as a bird watcher and a recreational user of the Freshwater Pond and an off-site recreational user involved in activities such as wading and fishing in the estuarine marsh between the site boundary and Swan Lake. As shown on Figure 3, the exposure pathways for the industrial workers and construction workers include inhalation of vapors from groundwater and subsurface soils, and ingestion, inhalation and dermal contact with surface soils and ingestion and dermal contact with subsurface soils (construction worker only). The exposure pathways for the on-site recreational user include inhalation of vapors from groundwater, surface and subsurface soils, ingestion, inhalation, and dermal contact with surface soils, and ingestion, inhalation, dermal contact with sediment and surface water in the Freshwater Pond, and ingestion of fish from the Freshwater Pond. Additional exposure pathways for the on-site recreational user include inhalation of vapors and dermal contact with surface water in the earthen impoundment. The differences in total exposure of the industrial worker, construction worker, and on-site recreational user will be due to differing exposure assumptions (e.g., exposure frequency, exposure duration, etc.).

The exposure pathways for the off-site recreational user include ingestion, inhalation, dermal contact with sediment, and and ingestion of fish. The off-site recreational user occasionally will visit the estuarine marsh between the site boundary and Swan Lake and will contact only sediment. In addition, the on-site and off-site recreational user could harvest fish for consumption.

There will be no quantitative assessment of the population northwest of the MSC Superfund Site unless the results for the industrial worker indicate an unacceptable risk from the inhalation pathways.

The following discussion summarizes the information relevant to determining the exposure pathways for the baseline risk calculations.

Direct contact with constituents in soil. It is assumed that all on-site receptors (industrial workers, construction workers and on-site recreational users) may directly contact surface soil through dermal contact and incidental ingestion. For all receptors, inhalation exposure may occur as a result of emanation of vapors from surface and subsurface soil to ambient air (volatile constituents only) and as a result of inhalation of windblown dust. The inhalation pathways of exposure will also be assessed for off-site receptors, a recreational user of the adjacent estuarine marsh.

Direct contact with constituents in groundwater. There is no current direct contact with constituents in groundwater by way of ingestion (i.e., use as drinking water) or dermal contact within the site boundaries because there are no active water supply wells located on-site. TDS concentrations exceeding 10,000 mg/L at some locations on the site suggest that shallow groundwater in the sand channel would not be considered potable water. USEPA Region 5 defines potable water where fresh/potable water generally refers to total dissolved solids concentrations of less than 3,000 mg/L. Direct contact with groundwater by residents off-site is not considered a potentially complete pathway because there are no residents adjacent to the site and therefore no users of groundwater in the hydraulically downgradient direction. The only reasonably anticipated complete human health pathway is inhalation of volatile emissions from constituents present in groundwater. The inhalation exposure pathway will be evaluated for an industrial worker, construction worker, and a recreational user of the site.

Off-site transport of constituents: Potential pathways for transport of constituents off-site include storm water runoff to the adjacent estuarine marsh and possible migration and discharge of constituents in groundwater to the estuarine marsh.

Direct Contact with Sediments and Surface Water*:* It is assumed that on-site recreational users may directly contact surface water and sediments in the Freshwater Pond by way of dermal contact, and that volatile constituents may be released from sediments and surface water to ambient air and become available for inhalation. On-site recreational users may also be exposed to constituents by incidental ingestion of water and sediment while swimming and ingestion of fish harvested from the Freshwater Pond. It is also assumed that an on-site recreational user may directly contact surface water in the earthen impoundment and that volatile constituents may be released from surface water in the earthen impoundment to ambient air and become available for inhalation.

For the recreational user of the off-site estuarine marsh, exposure is limited to dermal contact with and incidental ingestion of sediment during activities such as wading and ingestion of fish harvested from the estuarine marsh. The off-site recreational user also would be expected to inhale vapors that might emanate from sediment, as well as the on-site soil column and from on-site (and *in situ*) groundwater. It should be noted that off-site surface water is not a medium subject to investigation because water within the estuarine marsh is in direct communication with water within Swan Lake, a surface water body that has been the subject of the RI for the TexTin Superfund site.

A summary of the potential complete/incomplete pathways is provided below:

- The **industrial worker and construction worker**, under routine conditions, may be exposed to constituents in surface soil by way of dermal contact and incidental ingestion. Exposure also will occur as a result of inhalation of vapors present in the breathing zone that may have been released from the soil column above the saturated zone or from groundwater that directly underlies the worker. Construction workers may be exposed to constituents in subsurface soil by way of dermal contact and incidental ingestion.

- **On-site recreational users** of the on-site Freshwater Pond may be exposed to constituents in surface water and sediment that have received groundwater discharge and/or surface run-off. Dermal contact with and incidental ingestion of surface water and sediment such as during swimming or wading, as well as ingestion of fish that might be harvested from the Freshwater Pond, are potentially complete exposure scenarios. On-site, a recreational user also may be exposed to surface soil and particulates and/or vapors in the breathing zone released from soil or groundwater, if the site were to be used for recreational purposes. The on-site recreational user also would be expected to inhale vapors that might emanate from surface water and sediment in the Freshwater Pond, surface water in the earthen impoundment, as well as the on-site soil column and from on-site (and *in situ*) groundwater. The on-site recreational user may also experience dermal contact with surface water in the earthen impoundment.

- **Off-site recreational users** of the off-site marsh area may be exposed to constituents in sediment that have received groundwater discharge and/or surface run-off. Dermal contact with and incidental ingestion of sediment such as during wading, as well as ingestion of fish that might be harvested from the estuarine marsh, are potentially complete exposure scenarios. The off-site recreational user also would be expected to inhale vapors that might emanate from sediment, as well as the on-site soil column and from on-site (and *in situ*) groundwater. The off-site recreational user will not be evaluated for exposure to dust/particulates or volatile emissions released from on-site surface soil unless the evaluation of the on-site recreational user indicates unacceptable risk from this pathway.

The current CSM presented in Figure 3 will be refined based upon (a) the complete body of data collected to support the risk assessment, and (b) exposure area. Conceptual diagrams of potential exposure pathways and routes will be developed for each exposure area or if appropriate, group of exposure areas.

4.2.3 Exposure Point Concentrations

Exposure point concentrations (EPCs) will be determined for each COPC that remains after the data evaluation and screening process described in Section 3.1. Guidance (USEPA, 2004a) regarding the calculation of EPCs and other relevant literature will be used to determine a method that is applicable and appropriate to the data distribution for estimation of EPCs. The exposure point concentrations will either be the maximum reported concentration or the 95% Upper Confidence Limit (UCL) of the mean. The use of statistics for each exposure area will primarily depend on the number of samples collected in each area and the frequency of detection. However, a critical review of the data set will be conducted for each exposure area to assess whether the data are representative of the exposure area or are likely to be biased high or low. If necessary, the use of fate and transport models will be utilized to estimate EPCs, where considered appropriate (e.g., groundwater to surface water pathway, volatilization from soil and groundwater to ambient air).

4.2.4 Exposure and Intake Assumptions

In order to quantify exposure, different categories of variables are required to express the exposure that occurs over time as a function of the body weight of an individual. Each exposure and intake variable has a range of values for a given exposure pathway. Intake and exposure variables will be selected such that the estimate of the reasonable maximum exposure (RME) and the central tendency exposure (CTE) will be presented. The RME is the highest exposure that is reasonably anticipated to occur at a site and is intended to estimate a conservative exposure scenario that is within the range of possible exposures. The CTE represents most likely scenarios and is intended to estimate more realistic estimate of exposure and risk. The intake and exposure variables for each receptor route under RME and CTE scenarios will use values recommended in RAGS Part A and B (USEPA 1989 and USEPA 1991a, respectively), the USEPA's Supplemental Soil Screening Guidance (USEPA, 2001), the USEPA's dermal risk assessment guidance (USEPA 2004c), and USEPA's Exposure Factors

Handbook (USEPA 1997). Where appropriate, site-specific exposure input parameters will be used along with a reasoned justification.

In accordance with USEPA's (1991b) *Role of Baseline Risk Assessment in Superfund Remedy Selection*, the risk assessment results for the RME scenarios will be used in remedial decision-making.

4.2.5 Constituent Intake Equations

The risk assessment will use the standard chemical intake equations recommended by USEPA guidance (USEPA 1989, USEPA 1991a, USEPA 2002b, and USEPA 2004c) for estimating human intakes via ingestion, dermal, and inhalation exposure routes for soil, groundwater, sediment, and surface water (as applicable).

As explained in Section 2.1.8, the fish ingestion exposure pathway will be evaluated in the risk assessment by calculating hypothetical fish tissue concentrations from the sediment data. The risk assessment will calculate the hypothetical fish tissue concentration by partitioning the sediment concentration from either the maximum concentration or, if applicable, representative concentration into the fish by using published biota-sediment accumulation factors. If a biota-sediment accumulation factor is not available from literature, then a default value of 1 will be used.

4.3 Toxicity Assessment

The toxicity assessment summarizes the pertinent data concerning toxicological properties of constituents, and defines the toxicity values that will be used in risk characterization.

For the quantification of risk estimates for COPCs, the carcinogenic and non-carcinogenic effects of constituents will be taken into consideration. The risk assessment will use toxicity values developed by USEPA, unless justification for an alternate toxicity value is submitted. The following sources of information, in order of priority, will be used to identify toxicity values for COPCs with potential for human exposure (USEPA 2003):

- USEPA's Integrated Risk Information System (IRIS) – IRIS is updated regularly, provides verified reference doses, reference concentrations, slope factors (SFs), and unit risk factors, and is the agency's preferred source of toxicity information (http://www.epa.gov/iris/);
- USEPA's Provisional Peer Reviewed Toxicity Values (PPRTVs) – The Office of Research and Development/National Center for Environmental Assessment/Superfund Health Risk Technical Support Center develops PPRTVs on a chemical-specific basis when requested by USEPA's Superfund program staff (http://hhpprtv.ornl.gov); and

Tier 3 includes additional USEPA and non-USEPA sources of toxicity information. Priority is given to those sources of information that are the most current, the basis for which is transparent and publicly available, and which have been peer reviewed. Tier 3 toxicity values may include the following sources:

- Provisional or interim toxicity values recommended by USEPA's National Center for Environmental Assessment, as published in the most recent USEPA Region 6 MSSL tables (http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm).
- The California Environmental Protection Agency (Cal EPA) toxicity values are peer reviewed and address cancer and non-cancer effects. Cal EPA toxicity values are available on the Cal EPA internet website at http://www.oehha.ca.gov/risk/chemicalDB/index.asp.
- The Agency for Toxic Substances and Disease Registry (ATSDR) Minimal Risk Levels are estimates of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse non-cancer health effects over a specified duration of exposure. The ATSDR minimum risk levels are peer-reviewed and are available at http://www.atsdr.cdc.gov/mrls.html on the ATSDR website.
- USEPA's Health Effects Assessment Summary Tables (HEAST) – HEAST provides information on interim (not yet verified by USEPA workgroups) RfDs and SFs (USEPA 1997d).

If toxicity values from these sources are not available for a constituent detected at a site, and an alternative toxicity value is not justifiable, the lack of toxicity values will be discussed in the uncertainty assessment.

Dermal toxicity values are not available in USEPA's databases. In the absence of toxicity values applicable to the dermal route of exposure, oral toxicity values will be extrapolated to the dermal route using an *absorption adjustment* (USEPA 1989; USEPA 2004c). An absorption adjustment will be made to the oral toxicity factors (i.e., oral reference dose or oral cancer slope factor), which are generally based upon administered doses, to extrapolate to the dermal route if gastrointestinal absorption efficiency is less than 50 percent (USEPA 2004c).

The dermal pathway for soil (and sediment) requires the use of a dermal absorption factor (ABS.d); ABS.d represents the fraction of constituent in soil that is likely to be absorbed when applied to skin. The availability of data for dermal absorption of constituents from soil is very limited. The USEPA's dermal guidance provides specific values for a few constituents (USEPA 2004c). For all constituents that do not have specific ABS.d values (USEPA 2004c), the following default ABS.d values will be used: 0% for volatile organic constituents; 10% (0.1) for semivolatile constituents; and 0% for inorganic constituents. These absorption values are consistent with USEPA Region 6 values used to calculate MSSLs.

USEPA's approach to estimating lead toxicity and exposure risk as presented in the publications *Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil* (2003) will be used in the BLHHRA to estimate lead risks to workers and recreational users.

4.4 Risk Characterization

The exposure assessment and toxicity assessment will be integrated in the risk characterization to provide quantitative estimates of risk. For direct contact exposure scenarios, the risk characterization will include the derivation of risk estimates for each of the potential receptor(s) for each exposure area. In addition, cumulative cancer risk estimates and hazard index for COPCs will take into consideration the exposure for combined pathways for each receptor within each exposure area, and also combined pathways across media, where applicable.

Groundwater protection for purposes of protection of human receptors against adverse effects due to inhalation of volatile constituents emanating from groundwater will be evaluated by comparing reported soil concentrations to soil concentrations calculated in accordance with the Soil Screening Guidance (USEPA 1996b, USEPA 1996c, USEPA 2002). However, it should be noted that the Soil Screening Guidance allows the use of alternate soil leachate models in the evaluation of groundwater protection that vary in complexity and data requirements. MCP will consider the use of alternate approaches for soil leachate models in the evaluation of groundwater protection. The land use assumed for the exposure area will be taken into consideration for the derivation of groundwater protection cleanup levels. In addition, available leachate test results may be used to demonstrate the protection of groundwater quality. Site-specific soil concentrations for soil assuming leaching to groundwater with subsequent emanation of vapors from groundwater may be calculated if on-site soil concentrationos exceed the default screening values.

USEPA's acceptable risk ranges for cancer and non-cancer effects are presented in *Role of Baseline Risk Assessment in Superfund Remedy Selection Decisions (*USEPA 1991). MCP will consider the use of chemical-specific applicable or relevant and appropriate requirements (ARARs), if appropriate. Examples of ARARs include maximum contaminant levels, AWQC, and applicable air quality standards published by the Occupational Safety and Health Administration and other recognized authorities. It is not the intent to meet cleanup goals that are more stringent than applicable ARARs.

4.5 Uncertainty Analysis

Identification of uncertainty that could substantially alter the outcome of the risk assessment is an especially important part of the BLHHRA, for Risk Managers must use the results of the risk assessment as part of the knowledge base required for decision making in regard to remediation. Therefore, a qualitative uncertainty analysis will be included as part of the risk assessment. This section will present the uncertainties associated with each step of the risk assessment process, describe efforts made to minimize uncertainties in the risk assessment, and discuss how these uncertainties may impact the human health risk assessment results.

5.0 REFERENCES

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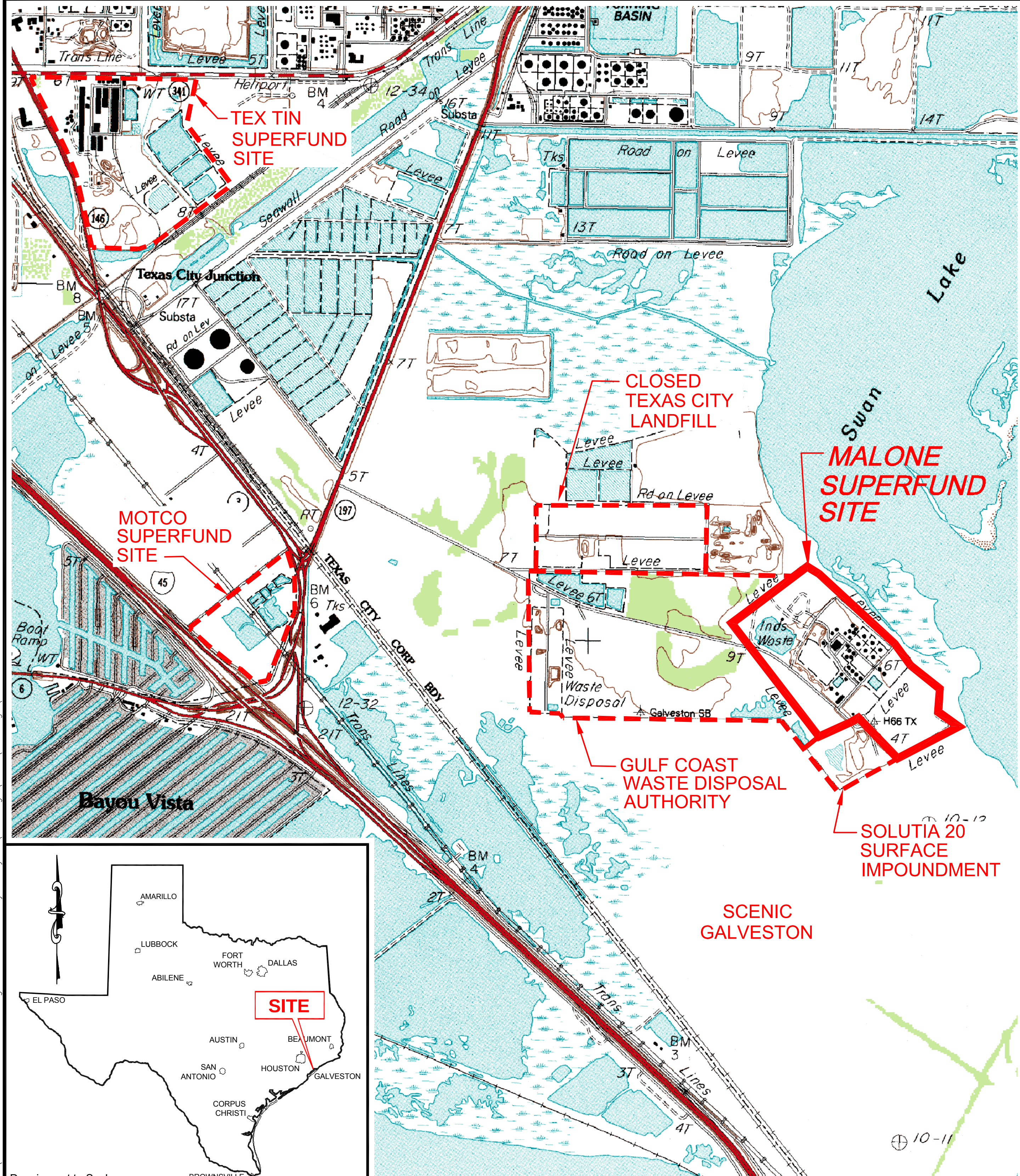
Figures

Figure 1 – Site Location Map

Figure 2- Site Map

Figure 3 – Conceptual Site Model

Figure 4 – 3-Dimensional Site Model



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Virginia Point, Texas Quadrangle, 1994.

URS
9801 WESTHEIMER, SUITE 500
HOUSTON, TEXAS 77042
PH: (713) 914-6699
FAX: (713) 789-8404

Title: **SITE LOCATION MAP**

Project: **MALONE SERVICE CO. SUPERFUND SITE**

Client: **MALONE COOPERATING PARTIES**

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DATE: 10-13-04
TIME: 8:00:45

AERIAL PHOTO DATED NOV. 20, 2003

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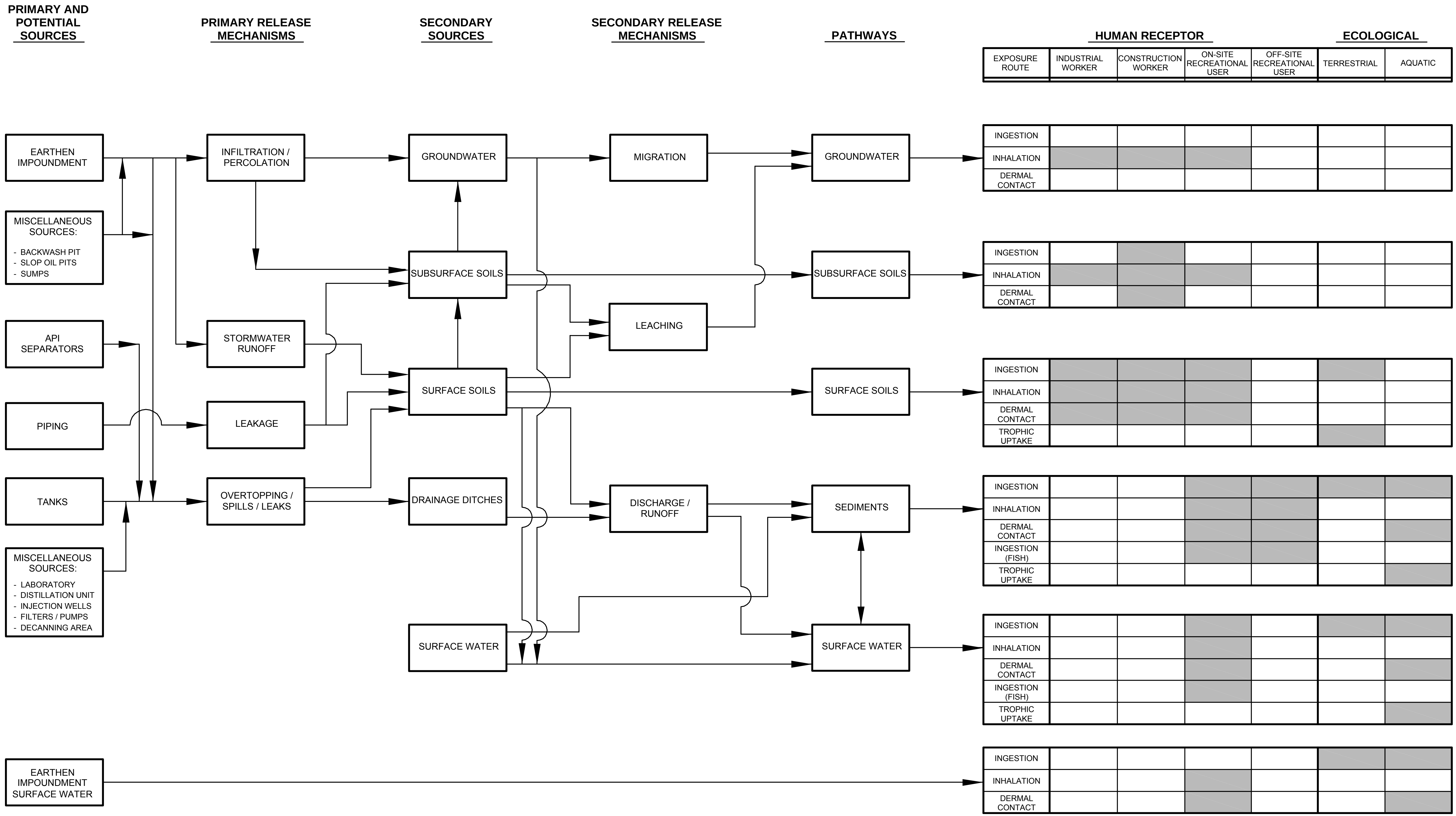

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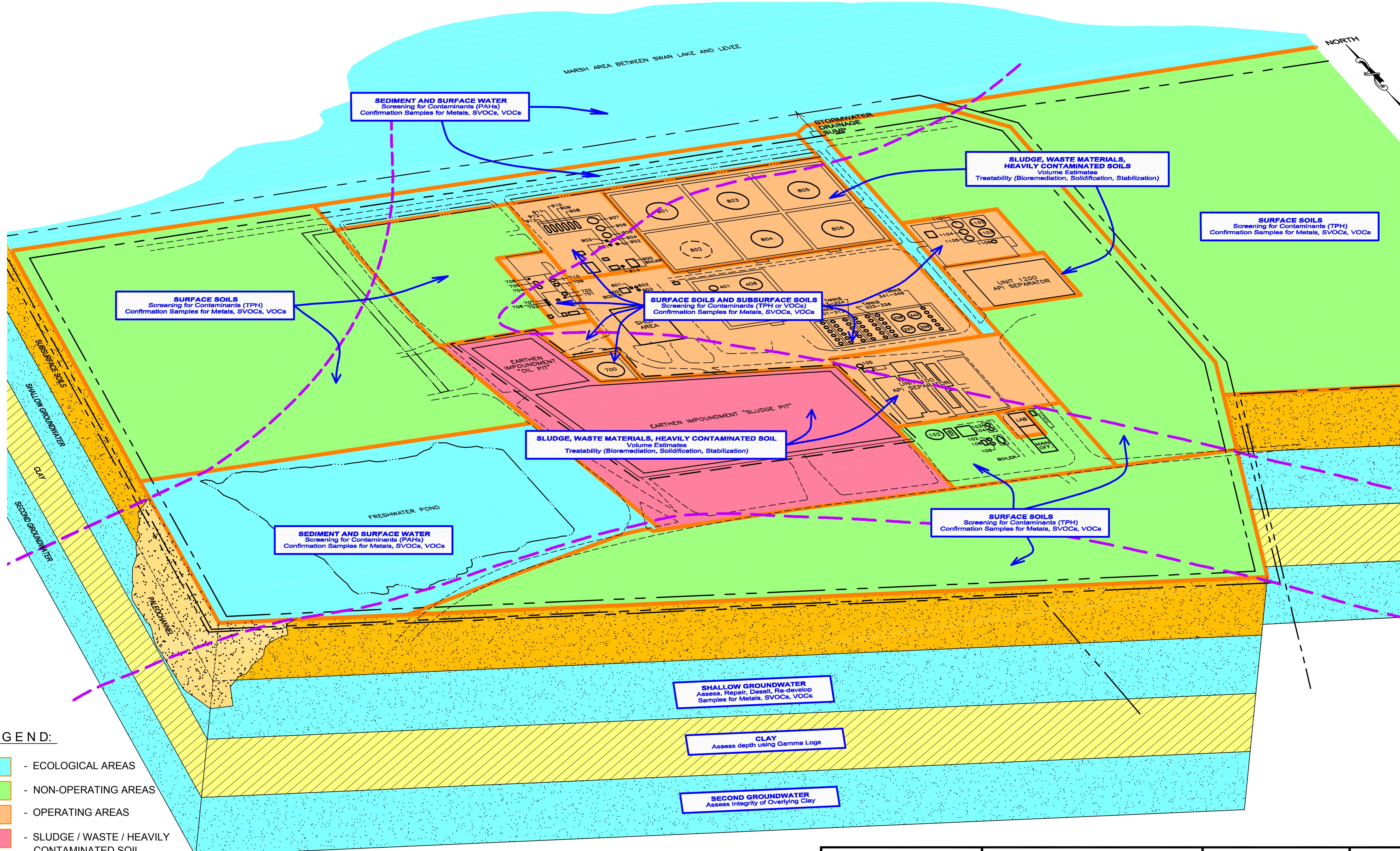

LEGEND:

- ECOLOGICAL AREAS
- NON-OPERATING AREAS
- OPERATING AREAS
- SLUDGE / WASTE / HEAVILY CONTAMINATED SOIL
- BOUNDARY PALEOCHANNEL

SOURCE:
BASE DRAWING OBTAINED FROM CLIENT AND WAS ORIGINATED BY ENVIRONMENTAL CONSULTING ASSOCIATES, AUSTIN, TEXAS, DATED SEPT. 1989.

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Appendix F – Ecological Risk Assessment Work Plan

TABLE OF CONTENTS

TABLES

FIGURES

ACRONYM LIST

API	American Petroleum Institute
ARARs	Applicable or relevant and appropriate requirements
BERA	Baseline Ecological Risk Assessment
bgs	below ground surface
COC	Constituents of Concern
COPCs	Constituents of Potential Concern
CSM	Conceptual Site Model
DQO	Data Quality Objectives
ERA	Ecological Risk Assessment
FSP	Field Sampling Plan
GCWDA	Gulf Coast Waste Disposal Authority
MSC	Malone Service Company
msl	mean sea level
NPL	National Priorities List
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PRAER	Preliminary Remedial Alternatives Evaluation Report
PSCR	Preliminary Site Characterization Report
QAPP	Quality Assurance Project Plan
RI/FS	Remedial Investigation/Feasibility Study
SAP	Sampling and Analysis Plan
SLERA	Screening-level Ecological Risk Assessment
SMDP	Scientific management decision point
SVOCs	Semivolatile Organic Compounds
TBC	To Be Considered
TCEQ	Texas Commission on Environmental Quality
UTL	Upper Tolerance Limit
USEPA	United States Environmental Protection Agency
VOCs	Volatile Organic Compounds

1.0 INTRODUCTION

The Malone Service Company, Inc. (MSC) site is located in Texas City, Galveston County, Texas, in an industrial and petrochemical area constructed on the shores of Swan Lake and Galveston Bay (Figure 1). The MSC Superfund Site was proposed to the National Priorities List (NPL) on August 24, 2000, and was placed on the NPL on June 14, 2001. An Administrative Order on Consent (the "Order") for the remedial investigation/feasibility study (RI/FS) was issued by the United States Environmental Protection Agency (USEPA) on September 29, 2003 to the Malone Cooperating Parties (Respondents).

1.1 Statement of Work

Included with the Order is a Statement of Work that describes the requirements for the Scoping Phase of the RI/FS. The Scoping Phase includes the following deliverables:

1. Preliminary Site Characterization Report (PSCR), which provides a summary of the known site information (URS 2004a);
2. Preliminary Remedial Alternatives Evaluation Report (PRAER), which selects preliminary remedial alternatives for impacted media at the site (URS 2004b);
3. Remedial Investigation/Feasibility Study Work Plan (RI/FS Work Plan);
4. Sampling and Analysis Plan (SAP) which includes the Field Sampling Plan (FSP) and the Quality Assurance Project Plan (QAPP); and
5. Health and Safety Plan.

The appendices of the RI/FS Work Plan contain various work plans, including this Ecological Risk Assessment (ERA) Work Plan. The objectives of this ERA Work Plan are to:

- state the problems and potential problems posed by the site, and
- describe the work to be performed in the ERA.

1.2 Work Plan Structure

This ERA Work Plan consists of the following sections:

- Section 1, Introduction, provides a statement of the purpose and structure of the report;
- Section 2, Site Background, discusses the MSC Superfund Site location, history, and operating units as well as the Conceptual Site Model (CSM), and the Preliminary Remedial Alternatives;
- Section 3, Work Plan Rationale, describes the basis for preparing the ERA Work Plan;
- Section 4, Screening Level Problem Formulation and Ecological Effects Characterization

(ERAGS STEP 1), describes the process for ERA activities; and

- Section 5, References, provides references for citations in the text.

Relevant information is contained in the following work plans:

1. The RI/FS Work Plan describes the overall focus of the RI/FS, tasks that will be accomplished during the RI/FS, a schedule and project management.
2. The FSP describes the sample locations and sampling protocols for the RI.
3. The QAPP describes the Data Quality Objectives (DQO) process, quality assurance/quality control criteria for the RI/FS, and lists analytes for the RI.

In addition, the PSCR (URS 2004a) and the PRAER (URS 2004b) provide detailed descriptions of the site setting and operations, previous investigations and remedial actions, and the preliminary remedial alternatives selection process.

2.0 SITE BACKGROUND AND PHYSICAL SETTING

2.1 Site Background

Prior to planning and implementing the RI/FS, the MCP have provided USEPA with a PSCR (URS 2004a) and a PRAER (URS 2004b). The PSCR:

- collected and analyzed existing data from relevant sources;
- developed a conceptual site model (CSM);
- developed a list of potential state and federal applicable or relevant and appropriate requirements (ARARs) and to-be-considered (TBC) advisories, criteria or guidance; and
- identified data needs.

The PRAER:

- developed remedial action objectives;
- expanded the list of potential state and federal ARARs and TBC advisories, criteria and guidance developed in the PSCR;
- developed and screened alternatives evaluated at similar waste sites;
- developed preliminary remedial alternatives for site media; and
- identified data needs.

Information from the PSCR and the PRAER are summarized below. In order to develop DQOs and to implement the Triad approach, it is necessary for the project team to understand the site, the CSM, the remedial action objectives and the preliminary remedial alternatives. These components, the site background, CSM, the remedial action objectives, the preliminary remedial alternatives, and required data, will be used to develop the DQOs and Dynamic Work Plan. The data gaps identified in the PSCR and the PRAER will be addressed during the RI/FS.

2.1.1 Site Description

This section summarizes the detailed site description presented in the PSCR (URS 2004a). Additional details are presented in Section 2.0 of the RI/FS Work Plan.

The MSC Superfund Site began operating in 1964 as a reclamation plant for waste oils and chemicals. The MSC Superfund Site received a variety of waste products from surrounding industries, including acids and caustics; contaminated residues and solvents; gasoline and crude oil tank bottoms; contaminated earth and water from chemical spill cleanups; general industrial plant wastes; phenolic tars; and waste oils. The liquids injected into the two deep wells included wastewater submitted to the facility for disposal, stormwater from the Sludge Pit, Oil Pit, and separators, and decontamination water collected in the separators. The facility was permitted to dispose of liquid hazardous and nonhazardous waste by means of deep well injection under Injection Well Permit Nos. WDW-73 and WDW-138. The MSC Superfund Site was permitted as a commercial storage, processing and disposal facility authorized to store and process industrial solid waste under Hazardous Waste Permit No. HW-50003 issued in September 1984. The permit authorized the discharge of stormwater runoff.

Operating units at the facility, as shown on Figure 2, included:

1. Earthen Impoundment (Sludge and Oil Pits)
2. Unit 100 American Petroleum Institute (API) Separator
3. Unit 300 tanks
4. Unit 400 tanks and sump
5. Unit 500 tanks
6. Unit 600 boiler
7. Unit 700 (WDW-73) injection well and sump
8. Unit 800 tanks and sump
9. Unit 900 distillation unit
10. Unit 1100 (WDW-138) injection well and sump
11. Unit 1200 API Separator
12. Laboratory and laboratory waste holding tanks

Other non-operating areas at the site included:

1. Decanning unit (operation not documented)
2. Laydown area
3. Freshwater pond
4. Drainage ditches
5. Cemetery
6. Former pits (Backwash pit and oil pits)
7. Undeveloped land

Physical operations ceased in January 1996 and the MSC Superfund Site has been inactive since then. In May 1997, the Texas Commission on Environmental Quality (TCEQ) revoked permits HW-50003, WDW-73 and WDW-138. Waste materials, two API separators, two underground injection wells, roll-off bins, a freshwater pond, sludge impoundment, numerous tanks containing liquid and sludge, chemicals within the facility laboratory, and metal drums inside small buildings were left on the MSC Superfund Site after the plant was closed.

2.1.2 Site Contamination

Impacts to groundwater were discovered at the MSC Superfund Site in 1979. Subsequently, samples collected in January 1986 from the Unit 100 API separator and the earthen impoundment exhibited hazardous waste characteristics with numerous organic and inorganic substances being detected.

Metals, such as antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc, were detected in the majority of samples, and barium was reported as present in the majority of samples analyzed for toxicity characteristic leaching procedure metals (URS 2004a).

The semivolatile organic compounds (SVOCs) detected in the source areas included polycyclic aromatic hydrocarbons (PAHs), phenolic compounds, and phthalate esters. The most frequently detected SVOCs were naphthalene, 2-methylnaphthalene, bis(2-ethylhexyl)phthalate, phenol, phenanthrene, 1,2,4-trichlorobenzene, and acenaphthene. Volatile organic compounds (VOCs) detected in the impoundments, separators and tanks included the aromatic and chlorinated hydrocarbons. The most frequently detected VOCs were total xylenes, ethylbenzene, tetrachloroethene, toluene, 1,1,1-trichloroethane, styrene, trichloroethene, and benzene.

Two Swan Lake locations near the MSC Superfund Site were characterized during the ERA for the TexTin Superfund Site (USEPA 1998). Figure 3 depicts the locations of the reference sediment samples (TT-14 and TT-15) collected for the TexTin ERA. One location was used as a reference for illustrative purposes, while the other location had the lowest concentration of chemicals of potential concern (COPCs) and, consequently, was selected as the habitat reference for the TexTin ERA. With the exception of arsenic, copper, lead, tin and zinc, the concentrations of metals were higher in Galveston Bay than in the southern portion of Swan Lake, that is the area tested by TexTin nearest the MSC Superfund Site. Analytical results were compared to literature values for adverse effects for the benthic macroinvertebrate community. Based on a comparison to literature values, the TexTin risk assessment concluded that the Swan Lake benthic community did not appear to be at risk from the copper, mercury, nickel, and zinc concentrations detected at the TexTin reference location, near the MSC Superfund Site (USEPA 1998a).

Acetone, carbon disulfide, methylene chloride, toluene, bis(2-ethylhexyl)phthalate and PAHs were detected in the background sediment samples collected by the TCEQ during the SSI. Figure 3 depicts the locations of the background sediment samples (SE-01/SE-02, SE-03 and SE-04) during the SSI. This background sample data was used by the TCEQ to evaluate potential releases from the MSC Superfund Site.

Two sediment samples (SE-13 and SE-14) were collected from drainage ditches located within the facility during the SSI. These samples contained benzene, ethylbenzene, toluene and total xylenes (BTEX), PAHs, phthalate esters, as well as the chlorinated hydrocarbons, hexachlorobutadiene, hexachlorobenzene, 2-chloronaphthalene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, and 1,2,4-trichlorobenzene. Chlorinated pesticides were reported present in one sample but pesticides and PCBs were not detected in the other on-site sediment sample. The concentrations of barium, beryllium, cobalt, lead, manganese, nickel, and vanadium reported for the two on-site samples were comparable to the range of concentrations detected in background samples. The concentration ranges for antimony, arsenic, cadmium, chromium, copper, and zinc were greater in the on-site drainage ditch samples than in the background samples. The sediments and soils in the MSC Superfund Site ditches were cleaned, scraped and/or excavated as part of the EPA's emergency responses, and the materials disposed of off-site (Zehner 2004).

Eight sediment samples (SE-05 through SE-12) were collected from outside the flood protection levee in the marsh area. Samples were collected from the drainage channel parallel to the north levee, and along the shorelines of Swan Lake, Campbell Bayou, and Galveston Bay. Acetone, carbon disulfide, methylene chloride, 2-butanone, and bis(2-ethylhexyl)phthalate were detected in these samples at concentrations comparable to the background samples. Other phthalate esters, di-n-butyl phthalate, di-n-octyl phthalate and diethyl phthalate were also detected in some of the samples. Total PAH concentrations in the eight sediment samples ranged from 0.067 mg/Kg to 0.945 mg/Kg and PCBs (Aroclor 1248, 1254 and 1260) were detected in four sediment samples. Trace detections of pesticides were reported for four samples. The concentrations of antimony, arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc in the off-site samples were greater than the range of concentrations in the background samples and in the TexTin reference samples. The maximum detections were generally in a sample located in the small drainage channel in the marshy area adjacent to the MSC Superfund Site and north of the stormwater discharge.

The CSM conveys what is known about the sources, releases, release mechanisms, contaminant fate and transport, exposure pathways, potential receptors and risks. The CSM is described in detail in Section 3.0 of the RI/FS Work Plan. Data collected during the RI will be used to verify and/or augment the model. The remedial action objectives and the DQOs are developed from the CSM.

2.1.3 Site Setting

The MSC Superfund Site is located on Campbell Bayou Road in Texas City, Galveston County, Texas, on the shores of Swan Lake and Galveston Bay, approximately 1.6 miles east-southeast of the intersection of Loop 197 and State Highway 3. The MSC Superfund Site encompasses approximately 150 acres. The operating area constituted approximately 75 acres. The MSC Superfund Site is bordered to the east and northeast by Galveston Bay and Swan Lake, which is an embayment of Galveston Bay. The closed Solutia South 20 waste disposal site borders the site on the southwest. Undeveloped land, owned by Scenic Galveston, in the form of marsh and wetlands, border the southern portions of the MSC Superfund Site. According to Scenic Galveston literature, this property is permanently deed restricted for habitat conservation and compatible public use. The Gulf Coast Waste Disposal Authority (GCWDA) Campbell Bayou facility is located on the western border of the facility. Northwest of the MSC Superfund Site is a closed Texas City landfill.

No residents live within one mile of the site. The nearest residential center to the MSC Superfund Site is Bayou Vista, approximately 1.5 miles to the southwest, across Interstate 45, along State Highway 6 (Figure 1). No public water supply or domestic drinking water wells have been identified within a one-mile radius of the MSC Superfund Site. One existing well reportedly drilled at the MSC Superfund Site in a deeper aquifer to supply water for site operations is located on the site near the Unit 700 injection well. GCWDA has one active fresh water supply well on-site. Water from this well is not used for drinking water purposes.

The Federal Emergency Management Agency Flood Rate Insurance Map for Texas City, Texas shows the area south of Texas City and east of Highway Loop 197 located within the 100-year flood plain. A flood protection levee surrounds the MSC Superfund Site. The levee was built with an average crest elevation of 5.5 m (18 ft) above mean sea level (msl), and with an average elevation of approximately 3 m (9 ft) above msl around the undeveloped area in the northeast corner of the MSC Superfund Site.

Rainfall runoff discharge and groundwater to surface water discharge from the MSC Superfund Site enter Texas Water Quality Segment 2439 – Lower Galveston Bay. The Lower Galveston Bay segment encompasses approximately 140 square miles. Galveston Bay is a highly productive nursery for oysters, bay shrimp and sport fish. Approximately 7,000,000 pounds of seafood were harvested from the Galveston Bay System annually from 1994 to 1998.

The shallow subsurface strata beneath the MSC Superfund Site primarily consists of an upper fine sandy to silty clay underlain by a low permeability, stiff red or gray clay to a depth of at least 40 to 45 feet below ground surface (bgs). The major limitation in the subsurface stratigraphy beneath the MSC Superfund Site is the absence of geologic data below 40 to 50 feet bgs. One groundwater supply well was reportedly drilled in 1968 to a depth of 750-ft bgs and screened across a sand interval between 700 and 750 feet bgs. A second well installed in 1975 to a depth of 200-ft bgs and screened across a sand interval between 185 to 198 feet had poor water quality. A thick clay interval more than 100 feet thick reportedly separates the buried paleochannel sand aquifer from the lower sand aquifer. Stratigraphic information from the adjacent GCWDA facility shows a 4-foot thick sand and silt zone at a depth of 88 feet bgs. It is unknown whether this permeable unit is laterally extensive beneath the MSC Superfund Site.

The hydrogeology in the immediate vicinity of the MSC Superfund Site is dominated by a prominent buried paleochannel that meanders southeast from Highway Loop 197 toward Galveston Bay and forms a wide arch beneath the MSC Superfund Site from the southwest to the southeast. A smaller distributary channel bifurcates from the main channel near the center of the MSC Superfund Site and trends to the north-northeast to Swan Lake. The surface expression of the buried paleochannel is evident on early aerial photographs by variations in soil type and vegetation.

2.1.4 Primary Sources and Release Mechanisms

Three primary sources (sources with the largest volume of impacted media) of potential COCs have been identified at the MSC Superfund Site:

1. the Earthen Impoundment (including both the "Oil Pit" and the "Sludge Pit");
2. the API separators (Units 100 and 1200); and
3. the tanks.

Miscellaneous potential sources (sources which may have released contaminants to soils and groundwater), such as the Closed Backwash Pit, the Laydown area in the northwest corner of the MSC Superfund Site, the distillation unit, the filters and pumps associated with the injection wells, the laboratory sumps and the decanning area, may have contributed to impacted soil and groundwater, but the current data are inadequate to make a determination.

As shown on Figure 4, potential primary release mechanisms from these sources included:

- infiltration and percolation from the earthen impoundment, the Closed Backwash Pit and the slop oil pits;
- spills from the loading and unloading of wastes at the earthen impoundment, the API separators and the tanks to the MSC Superfund Site soil;
- discharges (overtopping) and stormwater runoff from the earthen impoundment;
- overfilling, spilling and leaking of wastes from process area operations (separators, distillation units, and injection wells) to surface soil;
- leakage from ancillary piping to surface and subsurface soil; and
- infiltration and percolation from underground sumps (such as the laboratory sumps).

The earthen impoundment was constructed in the paleochannel that transects the MSC Superfund Site. Wastes placed within the earthen impoundment and other potential sources were released to the groundwater through dissolution or sorption onto fine particulate matter. Once dissolved or sorbed, the chemicals would migrate with the groundwater through the preferential flow in the paleochannel.

Potential COCs within the waste liquids and sludge placed in the earthen impoundment, the API separators, and the tanks may have been released to the MSC Superfund Site soil by discharges (overtopping), spills or leaks to surface soil or may have migrated into MSC Superfund Site soil through infiltration or percolation (subsurface soil). Rain and surface-water infiltration through impacted soil leaches the more water-soluble portions of the fluids resulting in the water-miscible fluids mixing with the groundwater and, depending on site characteristics, may migrate laterally.

Potential COCs residing in surface soil (0 - 2 feet), such as in the tank areas may be mobilized and transported by wind erosion, volatilization, or episodic surface runoff. These potential COCs in surface soil may also migrate vertically to subsurface soil by desorption and leaching processes and may potentially enter groundwater.

Potential COCs in the groundwater may migrate by advection and dispersion via groundwater flow, volatilize to soil gas and ultimately disperse into the atmosphere, or become adsorbed to aquifer soils.

Advection by means of groundwater flow may redistribute potential COCs to the shallow groundwater environment or transfer them to deeper aquifers. These potential COCs are subject to attenuation by chemical and biological degradation processes. The silt and sand in the vadose zone paleochannel increases the probability of impacted groundwater migration from the source to off-site receptors either in the marsh area between the MSC Superfund Site and Swan Lake or to the east (the closed Solutia South 20 waste disposal site).

2.1.5 Secondary Sources and Release Mechanisms

The primary releases may result in secondary sources: groundwater, on-site surface and subsurface soils and the on-site drainage ditches. Potential secondary release mechanisms from the soils at the MSC Superfund Site include:

- discharge/runoff to off-site surface water and off-site sediment;
- runoff from contaminated on-site soils to off-site surface water and off-site sediment;
- soil leaching to on-site groundwater; and
- groundwater migration off-site.

The mechanisms for releases from the sources, such as infiltration, percolation, advection and sorption, as discussed above also apply to the secondary sources.

2.1.6 Media

Based on the information provided in the environmental reports and summarized in the PSCR and PRAER, the following potentially impacted media have been identified:

- on-site and off-site sediments;
- on-site surface and subsurface soils;
- on-site surface water; and
- groundwater.

2.1.7 Exposure Pathways

Potential ecological exposure pathways for the MSC Superfund Site include:

- incidental ingestion of surface soil;
- incidental ingestion of on-site and off-site sediment;
- incidental ingestion of on-site surface water;
- dermal contact with surface soil;
- dermal contact with on-site and off-site sediment;

- dermal contact with on-site surface water; and
- ingestion of ecological prey that have ingested or accumulated contaminants by terrestrial receptors.

The potential for release of VOCs is high where the waste is potentially exposed to the atmosphere, such as in the Sludge Pit, and the Unit 100 and Unit 1200 API separators. Since the predominant wind direction is from the southeast, the population northwest of the MSC Superfund Site would be the potential receptors of air emissions. The Texas City Industrial Complex is northwest of the MSC Superfund Site.

The Unit 100, Unit 700, Unit 900, Unit 1100 and Unit 1200 areas are constructed on curbed concrete pads. The integrity of these concrete pads is unknown; therefore, the potential for releases to soils cannot be eliminated. The Unit 300, Unit 400, and Unit 800 tanks sit on native soil in areas bermed with native clay. The potential for releases to surface soils in these areas would be high. Depending on the subsurface stratigraphy, release potential to subsurface soils in these units would be low in areas constructed over the impermeable native clay, while the release potential to subsurface soils would be high in areas constructed over the paleochannel. Those units, such as the Sludge Pit and the Oil Pit, which are completed in the paleochannel, have a high release potential to soils and to groundwater.

Concentrations of metals, VOCs and SVOCs in the shallow groundwater bearing-unit indicate that groundwater has been impacted by releases from the MSC Superfund Site operations. These releases may have occurred from those units located above or within the paleochannel, such as the Unit 100 API separator and the earthen impoundment (the Sludge Pit and the Oil Pit).

Since the Freshwater Pond was excavated into the paleochannel, variations in the pond elevations correspond to variations in water levels of monitoring wells completed in the paleochannel demonstrating that the Freshwater Pond is hydraulically connected to groundwater. The pond collected stormwater runoff from areas of the facility and potentially may have accumulated contaminants. Contaminated on-site surface soils would drain to the on-site drainage ditches. Discharge/runoff from on-site drainage ditches was (and may currently be) channeled to the Freshwater Pond via the Laydown area or to off-site surface water and sediments through the stormwater discharge. If contaminants have accumulated within the pond, they may be released to groundwater and, depending on whether the hydraulic gradient from the Sludge Pit, Oil Pit and Unit 100 API separator is towards the pond, groundwater contaminants may be released to the pond.

2.1.8 Receptors

Figure 4 summarizes the selection of potential exposure pathways for evaluation in the RI/FS for the MSC Superfund Site. Multiple exposure routes for inhalation, ingestion, and dermal contact exist for each of the pathways listed above and for each of the type of receptors (human and ecological). Swan Lake is not included in the MSC Superfund Site assessment since this area was assessed/remediated as part of the TexTin Operable Unit 4.

Ecological receptors, both terrestrial and aquatic, are included in the CSM. The location of the facility and the presence of the Freshwater Pond and the marshy area between the MSC Superfund Site and Swan Lake indicate that the potential for exposure of both vertebrate and invertebrate species to site contaminants exists.

2.1.9 Remedial Action Objectives

In order to facilitate the selection of preliminary remedial alternatives, the site has been divided into remedial units. The remedial units were selected based upon the media, the types of contaminants, and the exposure scenario: groundwater, sludge and liquid wastes, on-site soils and sediments, and off-site sediments. The sludge and liquid wastes remedial unit includes material contained within the primary sources, the earthen impoundment, API separators, tanks, pits, and sumps. Structures were not included in the remedial units since they belong to the property owner. Sludge and liquid wastes remaining within structures such as tanks, sumps, or buildings are included in the sludge and liquid wastes remedial unit.

Remedial action objectives provide medium-specific (or remedial unit specific) goals for protecting human health and the environment. Using the CSM information discussed above, remedial action objectives were developed for each remedial unit. This section summarizes the remedial action objectives pertinent to the ERA.

The ecological remedial action objective for **groundwater** is to:

- restore groundwater to agreed risk-based cleanup levels protective of ecological exposure to surface water and sediments in the transitional zone (marsh area) between the site levee and Swan Lake.

The ecological remedial action objectives for **sludge and liquid wastes** are to:

- mitigate the release of contaminants from sludge and liquid wastes to surface soils and sediments to agreed ecological risk-based cleanup levels; and
- mitigate the release of contaminants from sludge and liquid wastes to surface water to agreed ecological risk-based cleanup levels.

The ecological remedial action objectives for **on-site soils and sediments** are to:

- mitigate ingestion by terrestrial ecological receptors of contaminants from surface soils to agreed risk-based cleanup levels;
- mitigate ingestion by terrestrial and aquatic receptors of contaminants from sediments to agreed risk-based cleanup levels;
- mitigate the ingestion (fish) by terrestrial receptors of contaminants from sediments to agreed risk-based cleanup levels; and

- mitigate migration of contaminants to surface water to agreed ecological risk-based cleanup levels.

The ecological remedial action objective for on-site surface water is to:

- restore surface water to agreed risk-based cleanup levels protective of ecological exposures in the Freshwater Pond.

The ecological remedial action objectives for the **off-site sediments** in the transitional zone (marsh area) between the MSC Superfund Site levee and Swan Lake are to:

- mitigate ingestion by terrestrial and aquatic receptors of contaminants from sediments to agreed risk-based cleanup levels;
- mitigate dermal contact by aquatic receptors of contaminants from sediments to agreed risk-based cleanup levels;
- mitigate migration of contaminants to surface water to agreed ecological risk-based cleanup levels; and
- restore sediments to agreed ecological risk-based cleanup levels.

An ecological remedial action objective for off-site surface water in the in the marshy area between the MSC Superfund Site and Swan Lake has not been developed since the area is tidally exchanged with Swan Lake and surface water would not necessarily reflect influences from the site and because remedial action objectives for sediment will effect a remedy of the surface water. .

2.1.10 Remedial Alternatives

The preliminary remedial alternatives selected in the PRAER were based on data and experience from the MSC Superfund Site and from other Superfund or related waste sites with similar settings, histories, and contaminants. This information was used to eliminate ineffective remedial alternatives and to evaluate effective remedial alternatives. The development of a preliminary remedial alternatives for affected media at the MSC Superfund Site did not eliminate the evaluation of other remedial alternatives during the FS if data developed during the RI indicate that other technologies may be more suitable for the site contaminants.

Treatment alternatives for potentially contaminated **sediments** containing organic compounds exceeding risk-based criteria were developed in the PRAER:

1. no action for on-site sediments.
2. natural siltation for off-site sediments in the marshy area east of the site between the flood protection levee and Swan Lake.

Identify Principal Study Questions

The MSC Superfund Site was divided into investigation units using information presented in the PSCR and PRAER. The operating units described in the PSCR and the remedial units described in the PRAER were used to determine remedial investigation units using the following criteria:

- operating history,
- aerial photographs,
- obvious impact from visual observations,
- risk before implementing any remedy, and
- risk after implementing a preliminary remedial alternative.

As shown in the three-dimensional CSM (Figure 5), the four site investigation units are:

1. Non-operating units
2. Operating units
3. Sludge and waste units
4. Ecological units

Non-operating units that are anticipated to have minimal impacted soils are shown in green. Operating units, which may have subsurface contamination from spills and materials handling, are shown in orange. Sludge and waste units, the earthen impoundment and API separators, are shown in red. The ecological investigation unit, including the Freshwater Pond, the drainage ditches, and the marsh area between the hurricane levee and Swan Lake, are shown in blue.

The non-operating investigation units contains the following areas:

1. Unused areas 1 and 2
2. Office area
3. Laydown area
4. Cemetery area, and
5. Borrow area.

The operating investigation unit areas include:

1. the laboratory area,
2. the WDW-138 deep well area,
3. the maintenance area (including the 300 through 700 units and the 900 unit), and
4. the 800 Tank area.

The principal study questions for ecological exposure may be stated as:

1. Do concentrations of COCs in on-site surface soils in non-operating units exceed site-specific risk-

based criteria established for ecological receptors?

2. Do concentrations of COCs in on-site surface water exceed site-specific risk-based criteria established for ecological receptors?

3. Do concentrations of COCs in on-site or off-site sediments exceed site-specific risk-based criteria established for ecological receptors?

Define Alternative Actions

The alternative actions that could result from the resolution of the principal study questions are to recommend that portions of the site (i) require no further evaluation or selection of a remedy; or (ii) warrant additional assessment or selection of a remedy. These alternative actions apply to the principal study questions for ecological risk in on-site surface water, on-site and off-site sediments, and on-site surface soil.

Develop Decision Statements

The principal study question and the alternative actions are combined into the following decision statements for the ERA.

1. Determine whether COC concentrations in on-site surface soils in non-operating units exceed site-specific risk-based ecological criteria and warrant additional investigations or a response action, or whether the COC concentrations are equal to or less than site-specific risk-based human health or ecological criteria and the on-site surface soils in operating units require No Further Action.

2. Determine whether COC concentrations in on-site surface water exceed site-specific risk-based ecological criteria and warrant additional investigation or a response action, or whether the COC concentrations are equal to or less than site-specific risk-based human health or ecological criteria and the surface water require No Further Action.

3. Determine whether COC concentrations in on-site and off-site sediments exceed site-specific risk-based ecological criteria and warrant additional investigations or a response action, or whether the COC concentrations are equal to or less than site-specific risk-based human health or ecological criteria and the sediments require No Further Action.

3.0 WORK PLAN RATIONALE

ERA activities for MSC Superfund Site will be conducted under USEPA's ***Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments*** (June 1997). This guidance document, referred to as ERAGS, describes an eight-step process. This eight-step process is shown in Figure 6. Only the first two steps (screening level) are presented at this time. Once the Screening Level Ecological Risk Assessment (SLERA) has been completed (Steps 1 and 2) using USEPA's Scientific Management Decision Point (SMDP) guidelines, a decision will be made as to the need for further ecological activities. If further ecological assessment is required, a Baseline Ecological Risk Assessment (BERA) Problem Formulation Report will be submitted to the USEPA for review and approval followed by a BERA Work Plan.

USEPA further describes the SLERA in its updated guidance: ***The Role of Screening Level Risk Assessments and Refining Contaminants of Concern in Baseline Ecological Risk Assessments*** (June 2001). SLERAs are conservative assessments in that they provide a high level of confidence in determining a low probability of adverse risk, and they incorporate uncertainty in a precautionary manner. SLERAs are not designed to generate cleanup goals and, in general, are not based on site-specific assumptions. SLERAs provide a general indication of the potential for ecological risk (or lack thereof) and may be conducted for several purposes including to: 1) estimate the likelihood that a particular ecological risk exists; 2) identify the need for site-specific data collection efforts; or 3) focus site-specific ERAs where warranted. The SLERA also allows constituents that do not pose an appreciable substantial ecological risk to be removed from the list of COPCs prior to conducting the BERA (USEPA, June 2001).

Another document that used to develop this SLERA methodology is the ***Guidance for Conducting Ecological Risk Assessments at Remediation Sites in Texas*** (TCEQ, 2001). This document provides the available ecological benchmarks for surface water, sediment, and soil media used as screening criteria in this SLERA.

The goal of the SLERA is to identify constituents of concern (COCs), areas, exposure pathways, and potential receptors for further evaluation in the BERA. COCs (or COPCs) are identified by comparison of the RI data to ecological screening benchmarks (Tables 1 to 3). Areas, exposure pathways, and potential receptors are identified after the ecological habitat assessment and development of the habitat food webs. An ecological habitat assessment will be incorporated into the SLERA and will identify ecological services provided by the different ecological areas present at the MSC Superfund Site. Example ecological services potentially present include nesting habitat for avian species or foraging areas for mammals. This assessment will also propose relevant, but simplified, food webs for various habitat types (e.g., upland terrestrial, the Freshwater Pond, and the marsh area). Receptors from different trophic guilds will be identified from the simplified food web models. The outcome of the SLERA will determine the need for the BERA, and if needed, the scope and depth of the BERA. Section 4 provides the details for performing the SLERA.

4.0 SCREENING ECOLOGICAL RISK ASSESSMENT

EPA further describes the SLERA in its ECO Update ***The Role of Screening Level Risk Assessments and Refining Contaminants of Concern in Baseline Ecological Risk Assessments*** (June 2001). SLERAs are conservative assessments in that they provide a high level of confidence in determining a low probability of adverse risk, and they incorporate uncertainty in a precautionary manner. SLERAs are not designed to generate cleanup goals and are not based on site-specific assumptions. SLERAs provide a general indication of the potential for ecological risk (or lack thereof) and may be conducted for several purposes including to: 1) estimate the likelihood that a particular ecological risk exists; 2) identify the need for site-specific data collection efforts; or 3) focus site-specific BERAs where warranted. The SLERA also allows constituents that do not pose a substantial ecological risk to be removed from the list of COPCs prior to conducting the BERA (USEPA June 2001).

4.1 Screening Level Problem Formulation and Ecological Effects Characterization (ERAGS STEP 1)

Problem Formulation is the first phase of the SLERA and establishes the goal, breadth, and focus of the assessment. It is a systematic planning step that identifies the major factors (e.g., affected property size and ecology, identity and distribution of ecological COPCs in affected media, potential ecological receptors) to be considered in the assessment and is linked to the regulatory and policy context of the assessment (USEPA 1997). The views and values of the various stakeholders concerned with the management of the site are discussed, coordinated, and prioritized (Wentsel et al., 1996). These factors determine the scope of the ERA (USEPA 1997). A BERA Problem Formulation Report will be submitted in Step 3 following this screening assessment if further assessment is warranted

For the screening-level problem formulation, a CSM is developed that addresses the following issues in a preliminary fashion:

- environmental setting and ecological COPCs;
- contaminant fate and transport pathways;
- mechanisms of ecotoxicity and categories of receptors likely affected;
- identification of complete exposure pathways; and
- selection of generic assessment endpoints.

Constituent exposure levels (i.e., screening benchmarks) that represent conservative thresholds for manifestation of adverse ecological effects are established in the ecological effects evaluation. Each of these major issues is further discussed below.

4.1.1 Identification of Environmental Setting and Ecological COPCs

The screening level problem formulation is initiated with an evaluation of the ecological environmental setting and determination of ecological COPCs. The environmental setting at MSC Superfund Site can be separated into general terrestrial and aquatic categories that constitute ecological areas to be investigated:

- Terrestrial Areas
  - non-habitat areas in the industrial operational areas (i.e., sludge pit, API separators, above ground storage tanks, and miscellaneous buildings) and
  - non-maintained and overgrown areas (non-operational areas such as the Laydown, borrow and unused areas).
- Aquatic Areas
  - Drainage Ditches
  - Freshwater Pond, and
  - the transitional zone (marsh area) between the levee and Swan Lake.

Further evaluation of the ecological resources provided by the ecological areas will be presented in the SLERA. The Field Sampling Plan (Appendix A of the RI/FS Work Plan) describes the sample media, sample locations, analytes, and other information relevant to the determination of nature and extent of contamination and for the evaluation of risk in the ecological areas.

4.1.2 Identification of Ecological COPCs

Ecological COPCs will be identified for each data group or area of study (e.g., Laydown area). If a constituent is not detected in a specific data group, it is eliminated from further consideration as an ecological COPC for that data group. For detected constituents, the ecological COPC identification process may involve evaluations such as comparison to background for inorganic constituents, comparison to ecological screening benchmarks, essential nutrient evaluation, examination of frequency of detection, and a weight-of-evidence evaluation of the relationship of a constituent to the site. Bioaccumulative constituents will be considered COPCs if they are detected, even if the detection is below the screening benchmark or background. Aluminum, a common element, is given special consideration based on soil pH.

Background Comparison

There are two ways to quantitatively compare site and background results: a comparison of individual site measurements to the site-specific background upper tolerance limit (UTL), if available, or Texas median value, and/or a comparison of the site average to the site-specific background average, if available (means comparison). An exceedance of the background UTL signals potential contamination that triggers further evaluation. Such exceedances may represent extreme observations from a population that is equivalent to a background population, or they may represent a contaminated population. A background means comparison provides additional information to determine if an inorganic constituent is present at naturally occurring concentrations or elevated due to site-related activities. Note that per USEPA 1997, inorganic constituents determined to be present at naturally occurring concentrations through a means comparison will not be eliminated as ecological COPCs requiring further evaluation in the SLERA, however the background information comparison will be presented in the SLERA conclusions.

Background information for organic constituents is not used to eliminate constituents from further evaluation, but may be used in the uncertainty analysis to help understand and interpret the estimated risks associated with the more ubiquitous organic constituents. Available data may include data collected from the site and information on concentrations of ubiquitous organic constituents encountered at similar locations in Texas. Where levels of constituents that are ubiquitous and widespread are difficult to distinguish from commonly encountered levels at non-impacted locations, additional area-specific background samples may be recommended as part of sampling for specific areas.

Comparison to Benchmark Screening Levels

Bioaccumulative constituents will be retained as COPCs in the SLERA and will not be eliminated based on comparison to benchmark screening values. For those constituents that are non-bioaccumulative, detected organic and inorganic constituents will be compared to media-specific screening benchmarks for soil, surface water and sediment. Detected are screened against media-specific screening benchmarks for soil, surface water and sediment. If additional benchmarks are need for the comparison, USEPA will be consulted to identify candidate benchmarks. If the maximum detected concentration of a non-bioaccumulative constituent in a data group does not exceed the lowest relevant ecological screening benchmark, it is eliminated from further consideration as an ecological COPC for that data group. Ecological screening benchmarks are listed in Tables 1 through 3. These tables are complete reproductions of the latest version of the TCEQ's benchmark table, including footnotes, and they may list constituents or situations not applicable to the MSC Superfund Site. A list of analytical constituents for the RI/FS is contained in the QAPP. If a constituent lacks sufficient toxicological information, and therefore does not have a screening level, it will be evaluated qualitatively in the uncertainty section of the SLERA.

Bioaccumulative Constituents

Constituents considered bioaccumulative will be evaluated in the SLERA, even if they are present at concentrations below a listed screening benchmark or background. Table 4 identifies all constituents listed as bioaccumulative (TCEQ 2001). These constituents may travel up the food chain (bioaccumulate and biomagnify) and cause adverse ecological impacts to upper trophic level receptors.

If a constituent is not a bioaccumulative constituent listed on Table 4 and is detected at a concentration below its screening benchmark, then the constituent will be removed from the SLERA.

Essential Nutrients

Biologically active elements include calcium, iron, magnesium, potassium, and sodium. These elements are essential for physiological processes, generally non-toxic, and usually found in high but variable concentrations in background samples. Furthermore, organisms generally have physiological processes for regulating internal concentrations of these elements. Therefore, biologically active elements have not been listed as analytes for the RI.

Aluminum

USEPA (September, 2002b) recognizes that due to the ubiquitous nature of aluminum, the natural variability of aluminum soil concentrations, and the availability of conservative soil screening benchmarks (Efroymson et al., 1997a and 1997b), aluminum is often identified as a COPC for ERAs. The commonly used soil screening benchmarks are based on laboratory toxicity testing using an aluminum solution that is added to test soil. Comparisons of total aluminum concentrations in soil samples to soluble aluminum-based screening values are deemed by USEPA to be inappropriate. Because the measurement of total aluminum in soils is not considered suitable or reliable for the prediction of potential toxicity and bioaccumulation, an alternative procedure is recommended for screening aluminum in soils. Potential ecological risks associated with aluminum are identified based on soil pH. Aluminum will be identified as an ecological COPC if the site is undergoing a complete SLERA and the soil pH is less than 5.5 (USEPA 2002b). This concept is reflected in Table 3 in that there are no toxicity benchmarks listed for aluminum and footnote d summarizes the application of a site-specific soil pH measurement.

Frequency of Detection

If more than 20 samples are collected in an exposure group and the detection frequency for a non-bioaccumulative constituent is less than 5%, that constituent will not be selected as an ecological COPC.

Relationship to Site

The pattern and distribution of a constituent at a site and known site history may provide additional information (to supplement available background information) relevant to whether or not the constituent is related to the site. Such information will not be used to eliminate a constituent from the list of ecological COPCs without USEPA concurrence. However, evidence that a constituent is not site-related will be discussed in the uncertainty assessment.

In cases where there is evidence to conclude that a constituent is not site-related, justification for eliminating the constituent as an ecological COPC may be prepared and submitted to the USEPA. The basis for removing any constituent from the process because it is not related to the area will be completely explained. If USEPA concurs that a constituent is not area related, that constituent would be eliminated from further risk quantification but would be discussed in the uncertainty section of the risk assessment.

Summary Statistics

Once the ecological COPCs have been determined for an area, summary statistics will be presented for detected constituents. For consistency with the human health risk assessment, summary statistics such as the 95% upper confidence limits, means, maximum detections for each medium and other values recommended in USEPA's *Risk Assessment Guidance for Superfund: Volume I Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments* (USEPA, 1998) will be appropriate for the ERA (both the SLERA and, possibly, a later BERA).

4.1.3 Determination of Contaminant Fate and Transport Pathways

During problem formulation, pathways for migration of a constituent (e.g., surface water runoff or groundwater to surface water migration) should be identified (USEPA 1997). These pathways are represented graphically in the ecological CSM found in Figure 4 and will be updated during the ERA process as necessary.

In addition to soil data, surface water and sediment data will be included in the ecological exposure evaluation. Groundwater will not be considered in this SLERA as the depth to groundwater is well beyond the effective rooting depths of vegetation in the general area. Surface soil (0-0.5 feet) will be used for direct exposure via ingestion to terrestrial receptors. The top 6 inches of sediment is the most biologically active, and data gathered from this zone will be used in the aquatic portion of the SLERA.

4.1.4 Description of Contaminant Mechanisms of Ecotoxicity and Categories of Receptors Likely Affected

Understanding the toxic mechanisms of a constituent helps to evaluate the importance of potential exposure pathways and to focus the selection of assessment endpoints. Some constituents, for example, affect primarily vertebrate animals by interfering with organ systems not found in invertebrates or plants (USEPA, June 1997). Mechanisms of ecotoxicity will be discussed in ecotoxicity profiles prepared for each final ecological COC in the SLERA.

The SLERA will focus on assessment of ecological communities and not individual- or population-based evaluation of upper trophic level receptors (the latter is reserved for the BERA). Ecological communities are a collection of plant and animal populations occupying the same habitat in which the various species interact with one another. However, for purposes of the SLERA, "communities" will refer to those groups whose exposure to ecological COPCs can be evaluated in terms of the media in which they reside (TCEQ August 2001). These communities consist of soil invertebrates, terrestrial vegetation, benthic invertebrates, and water column receptors (e.g., invertebrates and fish).

The development of habitat-specific food webs for the MSC Superfund Site will occur in Step 3 (BERA Problem Formulation), if necessary.

4.1.5 Identification of Complete Exposure Pathways and Selection of Generic Assessment Endpoints

Evaluating potential exposure pathways is one of the primary tasks of the screening-level ecological characterization of a site. For an exposure to be complete, a constituent must be able to travel from the source to ecological receptors and to be taken up by the receptors via one or more exposure routes. Potentially complete exposure pathways are listed in Section 2.1.7 of this work plan. Identifying complete exposure pathways prior to a quantitative evaluation of toxicity allows the assessment to focus on only those constituents that can reach ecological receptors.

For the SLERA, assessment endpoints are any adverse effects on ecological receptors, where receptors are plant and animal populations and communities, habitats, and sensitive environments. Adverse effects on populations can be inferred from measures related to impaired reproduction, growth, and survival. Adverse effects on communities can be inferred from changes in community structure or function. Adverse effects on habitats can be inferred from changes in composition and characteristics that reduce the habitats' ability to support plant and animal populations and communities (USEPA 1997).

4.1.6 Conceptual Site Models

The preliminary ecological CSM for the MSC Superfund Site is presented as Figure 4. The CSM is used to identify transport pathways of ecological COPCs from contamination sources, describes the environmental matrices that may be contaminated by constituent movement through the environment, describes possible exposure routes of ecological receptors to ecological COPCs, and defines the general classes of ecological receptors. The CSM is a visual representation of the linkages between site constituents and ecological receptors and provides a basis for identifying testable hypotheses of ecological COPC impacts on ecological resources (USAF 1999). Figure 5 presents a simple representative 3-dimensional CSM. The site specific CSM will be updated and revised as necessary during the SLERA process.

4.2 Screening Level Exposure Estimate and Risk Calculation (ERAGS Step 2)

In the screening level exposure estimates and risk calculations, only completed exposure pathways should be evaluated, but incomplete pathways must be documented, as they should be taken into account in the overall risk management decisions for the site.

4.2.1 Determination of Screening-Level Exposure Estimate

To estimate exposures for the SLERA, the highest measured or estimated contaminant concentration for each environmental medium will be used as the exposure concentration for an area. Use of maximum detected concentrations in the SLERA will ensure that potential ecological threats are not overlooked.

An assumption of 100% bioavailability will be applied to the SLERA, but a discussion of bioavailability will be provided in the weight of evidence and uncertainty analysis. Bioavailability is the ratio of a chemical that reaches a site of toxic action in an organism to the total load of that chemical in the environment. Uptake and elimination rates of the bioavailable forms are important criteria that govern body burdens, since the combined effects of these factors determine whether the material is accumulated or eliminated. Constituents may be inaccessible to ecological receptors because of chemical or physical binding to particles or chemical complexes.

4.2.2 Calculation of Risk Estimate

Ecotoxicity benchmark screening values (Tables 1 through 3) that are protective of communities in soil, sediment and surface water will be compared directly against media (i.e., soil, sediment and surface water) concentration data represented by maximum detected concentrations. Benchmarks can be based on a variety of endpoints using a variety of organisms. The benchmarks shown in Tables 1 through 3 are conservative screening values protective of communities. Ecological COPCs that exceed community-level ecotoxicity screening values but that do not subsequently prove to be a risk to higher trophic level receptors may still impact these community-level receptors. Risk to upper trophic level receptors will not be evaluated in this SLERA. Upper trophic impacts will be evaluated in the BERA if the SMDP determines that an upper trophic level assessment is necessary. The evaluation of the constituent detections in relation to the screening benchmarks will be provided for each ecological area.

4.2.3 Risk Characterization and Evaluation of Uncertainties

If all detections for non-bioaccumulators are less than their screening benchmarks, then the constituent alone is unlikely to cause adverse ecological effects.

If the SLERA indicates that adverse effects are possible at a site (i.e., detections greater than the benchmarks), then weight-of-evidence and uncertainty evaluations will be conducted. As appropriate, these analyses may include some of the following:

- evaluation of those constituents without screening benchmarks
- evaluation of the toxicity study or studies that the benchmark is based upon and their corresponding endpoint(s).
- evaluation of the uncertainty factors(s) used to develop the benchmark, if applicable.
- evaluation of ecological COPC bioavailability instead of assuming 100% bioavailability.

- evaluation of the potential for synergistic effects of constituents if there is information available that synergistic effects may occur.

4.2.4 Scientific Management Decision Point

At the end of Step 2, the risk assessors communicate the results of the SLERA to the project decision-makers (i.e., risk managers). Once it is determined that the information available is adequate to make a risk management decision, then the decision makers will choose one of the following conclusions:

- There is adequate information to conclude that ecological risks are negligible and therefore there is no need for remediation on the basis of ecological risk;
- The information is not adequate to make a decision at this point, and the ERA process will continue to Step 3 to re-define the goals and data gaps; or
- The information indicates a potential for adverse ecological effects, and a more thorough assessment is warranted (i.e., BERA).

For assessments that proceed to Step 3, the SLERA can indicate and justify which ecological COPCs and exposure pathways can be eliminated from further assessment because they are unlikely to pose a substantive risk.

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Tables

Table 1 Ecological Benchmarks for Surface Water

Constituent	Freshwater		Marine	
	Benchmark (mg/L)	Notes	Benchmark (mg/L)	Notes
Aluminum	0.099	c k		
Antimony	0.160	g		
Arsenic (d)	0.19	c w	0.078	c w
Barium	0.004	e		
Beryllium	0.0053	b		
Cadmium (d)	0.0006	c f	0.01	c w
Chromium (Hex) (d)	0.0106	c w	0.0496	c w
Chromium (Trivalent) (d)	0.1008	c f	0.103	g
Cobalt	1.5	b		
Copper (d)	0.007	c h w	0.0036	c h w
Cyanide (free)	0.0107	c i	0.0056	c i
Lead (d)	0.001	c f	0.0053	c w
Magnesium	3.23	b		
Manganese	0.12	e		
Mercury	0.0013	c	0.0011	c
Nickel (d)	0.0874	c f	0.0131	c w
Selenium	0.005	c	0.136	c
Silver (d, as free ion) See j for conversion	0.00008	c k w	0.0002	c k w
Silver (d)	0.0001	a f k	0.00019	a k
Thallium	0.004	g	0.0213	g
Vanadium	0.02	e		
Zinc (d)	0.0581	c f	0.0842	c w
Aldrin	0.0003	c k	0.00013	c k
alpha-BHC	0.074	b	0.025	b
beta-BHC	0.083	b		
delta-BHC	0.141	b		
gamma-BHC (Lindane)	0.00008	c	0.000016	b c
Chlordane	0.000004	c	0.000004	c

Table 1 Ecological Benchmarks for Surface Water

Constituent	Freshwater		Marine	
	Benchmark (mg/L)	Notes	Benchmark (mg/L)	Notes
4,4’-DDD	0.000011	e	0.000025	g
4,4’-DDE	0.0105	g	0.00014	g
4,4’-DDT	0.000001	c	0.000025	g
Dieldrin	0.000002	c	0.000002	c
Endosulfan I (alpha)	0.000056	c	0.000009	c
Endosulfan II (beta)	0.000056	c	0.000009	c
Endosulfan sulfate	0.000056	c	0.000009	c
Endrin	0.000002	c	0.000002	c
Endrin aldehyde	1.21	b		
Heptachlor	0.000004	c	0.000004	c
Heptachlor epoxide	0.0000038	a	0.0000036	a
Hexachlorocyclopentadiene	0.00007	b	0.00007	g
Methoxychlor	0.00003	c	0.00003	c
Polychlorinated biphenyls (PCBs, Aroclors)	0.0000014	c	0.00003	c
Toxaphene	0.0000002	c	0.0000002	c
Acenaphthene	0.023	o	0.0404	o
Anthracene	0.0003	b	0.00018	b
Benzo(a)anthracene	0.0346	b		
Benzo(a)pyrene	0.000014	e		
Chrysene	0.007	b		
Dibenz[a,h]anthracene	0.005	b		
Fluoranthene	0.00616	o	0.00296	o
Fluorene	0.011	b	0.05	b
2-Methylnaphthalene	0.063	b	0.03	b
Naphthalene	0.25	b	0.125	b
Phenanthrene	0.03	c	0.0046	c
Pyrene	0.007	b	0.00024	b
Biphenyl (diphenyl)	0.014	e m		

Table 1 Ecological Benchmarks for Surface Water

Constituent	Freshwater		Marine	
	Benchmark (mg/L)	Notes	Benchmark (mg/L)	Notes
Bis (2-Chloroethyl) Ether	12	b		
Bis(chloroisopropyl) ether	6.3	b		
Bis (2-ethylhexyl)phthalate	0.007	b		
Bis (n-octyl) phthalate	0.022	b		
4-Bromophenyl phenyl ether	0.0015	e m		
Butyl benzyl phthalate	0.093	b	0.147	b
2-Chloronapthalene	0.054	b		
2-Chlorophenol	0.13	b	0.265	b
Di-n-butyl phthalate	0.007	b	0.005	b
Dibenzofuran	0.094	b	0.065	b
3,3’-Dichlorobenzidine	0.053	b	0.037	b
2,4-Dichlorophenol	0.085	b		
Diethyl phthalate	1.04	b	0.442	b
Dimethylphthalate	0.33	g	0.58	g
2,4-Dimethylphenol	0.105	b		
2,4-Dinitrophenol	0.031	b	0.67	b
2,4-Dinitrotoluene	1.22	b		
Isophorone	6	b	0.65	b
Methyl tert-butyl ether (MTBE)	11.07	b		
3-Methyl-4-Chlorophenol	0.0003	g		
2-Methyl-4,6-Dinitrophenol (dinitro-o-cresol)	0.012	b		
4-Methylphenol (p-cresol)	0.272	b		
2-Methylphenol (o-cresol)	0.56	b	0.51	b
N-Nitrosodiphenylamine	0.29	b	165	b
4-Nitrophenol	0.532	b	0.359	b
Nitrosodi-n-propylamine	0.02	b	0.12	b
Pentachlorophenol	0.0021	c p	0.0096	c
Phenol	0.11	n	2.75	b

Table 1 Ecological Benchmarks for Surface Water

Constituent	Freshwater		Marine	
	Benchmark (mg/L)	Notes	Benchmark (mg/L)	Notes
2,4,5-Trichlorophenol	0.064	c	0.012	c
2,4,6-Trichlorophenol	0.0135	b	0.061	b
Acetone	101.2	b	282	b
Benzene	0.13	e	0.109	g
Bromodichloromethane	2.16	b		
2-Butanone (MEK)	42.4	b		
Carbon disulfide	0.105	b		
Carbon tetrachloride (Tetrachloromethane)	0.0098	e	1.5	g
Chlorobenzene	0.064	e	0.105	g
Chlorodibromomethane (dibromoch1oromethane)	0.129	b		
Chloroform	0.89	q	4.1	q
Chloromethane	28	b	13.5	b
Cumene (isopropylbenzene)	0.255	b		
1,2-Dichlorobenzene	0.11	b	0.099	b
1,3-Dichlorobenzene	0.085	b	0.142	b
1,4-Dichlorobenzene	0.11	b	0.099	b
Dichlorodifluoromethane (Freon-12)	1.96	b		
1,1-Dichloroethane	2.57	q		
1,2-Dichloroethane	6.3	q	5.65	q
1,1-Dichloroethene	1.5	q	12.5	q
1,2-Dichloroethene (mixed cis & trans isomers)	14	q	0.68	q
1,2-Dichloroethene (trans)	22	q		
1,2-Dichloropropane	1.87	b	2.4	g
Ethylbenzene	1.09	b	0.250	b
Hexachlorobutadiene	0.00093	g	0.00032	g
Hexachloroethane	0.012	e m	0.0094	g
2-Hexanone (methyl butyl ketone; MBK)	6.13	b		

Table 1 Ecological Benchmarks for Surface Water

Constituent	Freshwater		Marine	
	Benchmark (mg/L)	Notes	Benchmark (mg/L)	Notes
4-Methyl-2-pentanone (MIBK)	26.4	b	61.5	b
Methyl Bromide (bromomethane)	0.11	b	0.6	b
Methylene Chloride (dichloromethane)	11	q	5.42	q
Nitrobenzene	0.27	g	0.0668	g
Styrene (vinyl benzene)	1.25	b	0.455	b
1,1,2,2-Tetrachloroethane	0.465	b	0.451	b
Tetrachloroethene	0.79	q	1.45	q
Toluene	1.45	q	0.48	q
Tribromomethane (bromoform)	0.149	b	1.22	b
1,2,4-Trichlorobenzene	0.051	b	0.022	b
1,1,1-Trichloroethane	2.45	q	1.56	q
1,1,2-Trichloroethane	0.90	b	0.275	b
Trichloroethene	0.55	b	0.97	q
Trichlorofluoromethane (Freon-11)	0.871	b		
1,1,2-Trichlorotrifluorethane (Freon-113)	0.207	b		
Vinyl chloride (chloroethylene)	2.82	b		
m-Xylene	0.0018	e m		
Xylenes	1.34	q	0.85	q

Note: The screening benchmarks and the following notes are taken d from Table 3-2 Ecological Benchmarks for Water from TCEQ 2001. Table 3-2 update on July 23, 2003.

a) U.S. USEPA, 2002

b) TCEQ Water Quality Division, 2003. In-house water quality chronic and acute values derived from wastewater permits and requests from the Office of waste based on LC50 values in accordance with methodology defined in the TSWQS.

c) Texas Surface Water Quality Standards Chronic (unless otherwise noted) Criteria (30 TAC § 307.6 Table 1. Effective August 17, 2000)

d) Indicates that the criteria for a specific parameter are for the dissolved portion in water.

e) Tier II Secondary Chronic Values from Suter and Tsao (1996).

f) Criteria calculated using a hardness value of 50 mg/L. See formula for standard that follows.

g) U.S.USEPA Region 4. 1999. Value derived from Region 4 Water Quality Management Division screening worksheet.

h) In designated oyster waters an acute saltwater copper criterion of 3.6 micrograms per liter applies outside of the mixing zone of permitted discharges, and specified mixing zones for copper will not encompass oyster reefs containing liver oysters.

i) Compliance will be determined using the analytical method for cyanide amenable to chlorination or by weak acid dissociable cyanide.

j) Based on the procedure defined in TCEQ (2003), the percent dissolved silver that is in the free ionic form is estimated from the following regression equation:

Y = exp[exp1/ (0.6559 + 0.0044(Cl))]

Where Y = % of dissolved silver that is free ionic form, and Cl = dissolved chloride concentration (mg/L) Persons should use the 50th percentile chloride value (from TCEQ, 2003) for the nearest downstream segment unless site-specific data is available. Because there is no readily available means to predict the percent free ion in marine waters, silver should be evaluated as dissolved silver alone.

k) There is only an acute criterion (no chronic criterion). The indicated value is the acute criterion divided by 10.

l) State of Colorado hardness-based water quality standard (Colorado Department of Public Health and Environment, CDPHE, 1999).

m) Values calculated for OSWER 1996 as provided by Suter and Tsao (1996).

n) Values calculated using the Great Lakes Water Quality Initiative Tier I methodology (U.S. USEPA 1993a) as provided by Suter and Tsao (1996).

o) These numbers are FCVs calculated by the USEPA for use in the derivation of the sediment quality criteria (U.S. USEPA, 1993 b, c)

p) Criteria calculated using a pH of 6.0. See formula for standard that follows.

q) Value derived by work group using the LC50 approached discussed in Section 3.5.3 (of TCEQ, 2001). Contact the TCEQ Technical Support Team (TARA) for a full description of each value.

Cadmium – 0.909 w$e^{(0.7852 (\ln(\text{hardness})) -3.490)}$	Chromium (tri) - 0.860 w$e^{(0.8190 (\ln(\text{hardness})) + 1.561)}$
Copper - 0.960 w$e^{(0.8545 (\ln(\text{hardness})) -1.386)}$	Lead - 0.729 w$e^{(1.273 (\ln(\text{hardness})) – 4.705)}$
Nickel - 0.997 w$e^{(0.8460 (\ln(\text{hardness})) + 1.1645)}$	Pentachlorophenol - $e^{(1.005 (\text{pH}) – 5.290)}$
Zinc - 0.986 w$e^{(0.8473 (\ln(\text{hardness})) + 0.7614}$	Silver – (0.85)$e^{(1.72 (\ln(\text{hardness})) – 6.59)}$
Uranium – $e^{(1.1021 (\ln(\text{hardness})) + 2.2382)}$	

w) Indicates that the criterion in multiplied by a water-effects ration in order to incorporate the effects of local water chemistry on toxicity. The water-effects ratio is equal to 1 except where sufficient data are available to establish a site-specific, water-effects ratio. Water-effects rations for individual water bodies are listed in Appendix E of the TSWQS. The number preceding the w in the freshwater criterion equation in an U.S. USEPA conversion factor.

Table 2 Ecological Benchmarks for Sediments

Constituent	Freshwater		Marine	
	Benchmark (mg/L)	Notes	Benchmark (mg/L)	Notes
Antimony	2	a		
Arsenic	9.79		8.2	
Cadmium	0.99		1.2	
Chromium (Total)	43.4		81	
Cobalt	50	b		
Copper	31.6		34	
Lead	35.8		46.7	
Manganese	460	b		
Mercury	0.18		0.15	
Nickel	22.7		20.9	
Silver	1	a	1	
Zinc	121		150	
Acenaphthene	0.0067	j	0.016	j
Acenaphthylene	0.0059	j	0.044	j
Anthracene	0.0572		0.0853	j
Benzo(a)anthracene	0.108		0.261	j
Benzo(a)pyrene	0.150		0.43	j
Chrysene	0.166		0.384	j
Dibenz(a,h)anthracene	0.033		0.0634	j
Fluoranthene	0.423		0.6	j
Fluorene	0.0774		0.019	j
2-Methylnaphthalene			0.070	j
Naphthalene	0.176		0.160	j
Phenanthrene	0.204		0.24	j
Pyrene	0.195		0.665	j
Low molecular weight PAHs			0.552	f g j
High molecular weight PAHs			1.7	f h j

Table 2 Ecological Benchmarks for Sediments

Constituent	Freshwater		Marine	
	Benchmark (mg/L)	Notes	Benchmark (mg/L)	Notes
Total PAH	1.61	f j	4.022	f i j
Aldrin	0.002	b		
PCB 1254	0.060	b		
PCB 1016	0.007	b		
PCB 1260	0.005	b		
PCB 1248	0.030	b		
Total PCBs	0.0598	f	0.0227	f
alpha-BHC	0.006	b		
beta-BHC	0.005	b		
gamma-BHC (Lindane)	0.00237		0.00032	b
Chlordane (Total)	0.00324		0.00226	d
Dieldrin	0.0019		0.000715	d
Endrin	0.00222			
Sum DDE (sum of p,p and o,p isomers)	0.00142		0.00207	d f
Sum DDD (sum of p,p and o,p isomers)	0.00354		0.00122	d f
Sum DDT (sum of p,p and o,p isomers)	0.00119		0.00119	d f
Total DDT	0.007	f	0.00158	f
Hexachlorobenzene (HCB)	0.02	b		
Hexachlorobutadiene (HCBD)	0.055	k		
Heptachlor epoxide	0.00247			
Toxaphene	0.00010	k		
bis(2-Ethylhexyl)phthalate	0.182	d	0.182	d
Diethyl phthalate	0.630	m		
Acetone	60.03	n	167.23	n
Tert-butylbenzene	1.21	n		
Bromodichloromethane	2.46	n		
2-Butanone	25.71	n		
Carbon disulfide	0.12	n		

Table 2 Ecological Benchmarks for Sediments

Constituent	Freshwater		Marine	
	Benchmark (mg/L)	Notes	Benchmark (mg/L)	Notes
Carbon tetrachloride	0.02	n	3.67	n
Chlorobenzene	0.17	n	0.29	n
Chlorodibromomethane	0.16	n		
Chloroform (trichloromethane)	0.94	n	4.30	n
Chloromethane	17.80	n	8.74	n
1,2-Dichlorobenzene	0.83	n	0.74	n
1,3-Dichlorobenzene	0.19	n	0.32	n
1,4-Dichlorobenzene	0.77	n	0.70	n
Dichlorodifluoromethane	3.68	n		
1,1-Dichloroethane	2.32	n		
1,2-Dichloroethane	4.79	n	4.30	n
1,1-Dichloroethene	1.87	n	15.41	n
1,2-Dichloroethene (trans)	23.95	n		
1,2-Dichloropropane	2.20	n	2.82	n
Ethylbenzene	2.86	n	0.65	n
Hexachlorobutadiene	0.06	n	0.02	n
Hexachloroethane	0.23	n	0.18	n
2-Hexanone	4.70	n		
4-Methyl-2-pentanone (MIBK)	19.43	n	45.34	n
Methyl bromide (Bromomethane)	0.08	n	0.42	n
Methylene chloride	7.75	n	3.82	n
Nitrobenzene	0.51	n	0.13	n
Styrene	10.24	n	3.72	n
1,1,2,2-Tetrachloroethane	0.63	n	0.61	n
Tetrachloroethene	1.69	n	3.10	n
Toluene	2.88	n	0.94	n
Bromoform	0.22	n	1.78	n
1,2,4-Trichlorobenzene	0.88	n	0.39	n

Table 2 Ecological Benchmarks for Sediments

Constituent	Freshwater		Marine	
	Benchmark (mg/L)	Notes	Benchmark (mg/L)	Notes
1,1,1-Trichloroethane	4.13	n	2.63	n
1,1,2-Trichloroethane	0.98	n	0.30	n
Trichloroethene	0.84	n	1.47	n
Trichlorofluoromethane	1.69	n		
1,1,2-Trichlorotrifluoroethane	2.78	n		
Vinyl chloride	1.96	n		
Xylenes	4.00	n	2.54	n

Note: The screening benchmarks and the following notes are taken from Table 3-3 Ecological Benchmarks for Sediment from TCEQ, 2001. Table 3-3 update on February 24, 2004 (Ecological Work Group Meeting Notes).

Freshwater – Unless otherwise notes, benchmarks are Threshold Effect Concentrations (TEC) from: MacDonald, D.D., C.G. Ingersoll, and T.A. Berger. 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. Arch. Environ. Contam. Toxicol. 39:20-31.

Marine – Unless otherwise noted, benchmarks are Effects Range Low (ERL) from: Long, E.R, D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. Incidence of Adverse Biological Effects Within Ranges of Chemical Concentrations in Marine and Estuarine Sediments. Environ. Manage. 19(1):81-97.

a) Effects Range Low (ERL) from: Long, E.R. and L.G. Morgan. 1990. The Potential for Biological Effects of Sediment-sorbed Contaminants Tested in the National Status and Trends Program. NOAA Technical memorandum NOS OMA 52, March 1990.

b) Lowest Effect Level (LEL) from: Persaud, D., R. Jaagumagi and A. Hayton. 1993. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario. Water Resources Branch. Ontario Ministry of the Environment and Energy. August.

c) Interim Sediment Quality Guidelines (ISQG) from: Environment Canada. 1997. Canadian Sediment Quality Guidelines for DDTs. Environment Canada, Guidelines and Standards Division. January, 1998 Draft.

d) Threshold Effects Level (TEL) from: Smith, S.L., D.D. MacDonald, K.A. Keenleyside, and C.L. Gaudet. 1996b. The Development and Implementation of Canadian Sediment Quality Guidelines. In: Development and Progress in Sediment Quality Assessment: Rationale, Challenges, Techniques & Strategies. Ecovision World Monograph Series. Munawar & Dave (Eds.). Academic Publishing, Amsterdam, The Netherlands.

e) When benchmarks represent the sum of individual compounds, isomers, or groups of congeners, and the chemical analysis indicates an undetected value, the proxy value specified at §350.51(n) shall be used for calculating the sum of the respective compounds, isomers, or congeners. This assumes that the particular COC has not been eliminated in accordance with the criteria in §350.71 (k).

f) The low molecular weight PAH benchmark is to be compared to the sum of the concentrations of the following compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, and 2-methylnaphthalene. The PAH benchmark is not the sum of the corresponding benchmarks listed for the individual compounds.

g) The high molecular weight PAH benchmark is to be compared to the sum of the concentrations of the following compounds: fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(a)pyrene, and dibenzo[a,h]anthracene. The PAH benchmark is not the sum of the corresponding benchmarks listed for the individual compounds.

h) Total PAH refers to the sum of the concentrations of each of low and high molecular weight PAHs listed above and any other PAH compounds that are not eliminated in accordance with §350.71 (k).

i) The benchmarks for total PAHs are the most relevant in evaluating risk in an ERA as PAHs usually occur as mixtures. Values for individual, low molecular weight, and high molecular weight PAHs are provided as guidelines to aid in the determination of disproportionate concentrations within the mixture that may be masked by the total. See discussion in Section 3.5.4 (from TCEQ 2001).

j) CCME (Canadian Council of Ministers of the Environment). 1999. Canadian environmental quality guidelines. Winnipeg, Manitoba.

k) NYSDEC (New York State Department of Environmental Conservation). 1999.Technical guidance for screening contaminated sediments. Division of Fish, Wildlife, and Marine Resources. Albany, New York. 36 pp.

l) Stortelder, P.B., M.A. Vandergaag, and L.A. van der Kooij. 1989. Perspectives for water organisms. An ecotoxicological basis for quality objectives for water and sediment. Part 1. Results and Calculations. DBW/RIZA Memorandum N. 89.016a. (English Version August, 1991). Institute for Inland Water Management and Waste Water Treatment. Lelystad, Netherlands.

m) U.S.USEPA. 1997. The incidence and severity of sediment contamination in surface waters of the United States. Volume 1: National sediment quality survey. USEPA 823-R-97-006. Office of Science and Technology (4305). Washington, District of Columbia.

n) Benchmarks derived using formula in: Fuchsman, P.C. 2003. Modification of the Equilibrium Partitioning Approach for Volatile Organic Compounds in Sediment. Environ. Toxicol. Chem. 22:1532-1534. Surface water benchmarks from Table 3-2 (TCEQ 2001) used for water quality values.

Table 3 Ecological Benchmarks for Soil

Constituent	Earthworm Benchmark [a] (mg/kg)	Earthworm Notes	Plant Benchmark [b] (mg/kg)	Plant Notes	Texas Median Background [c]
Aluminum (d)					30,000
Antimony	78	e f	5		1
Arsenic	60		37	g	5.9
Barium	330	f h	500		300
Beryllium	40	f i	10		1.5
Bromine			10		
Cadmium	140	f j	29	g	
Chromium (Total)	0.4		5	g	30
Cobalt			13	k	7
Copper	61	f g	100		15
Lead	500		50		15
Lithium			2		
Manganese			500		300
Mercury	0.1		0.3		0.04
Nickel	200		30		10
Selenium	70		1		0.3
Silver			2		
Thallium			1		9.3
Tin			50		0.9
Vanadium			2		50
Zinc	120	f, g	190	g	30
Acenaphthene			20		
Fluorene	30				
Biphenyl (diphenyl)			60		
1,4-Dichlorobenzene	20				
Di-n-butyl phthalate			200		
Diethyl phthalate			100		
Dimethylphthalate	200				

Table 3 Ecological Benchmarks for Soil

Constituent	Earthworm		Plant		Texas Median Background [c]
	Benchmark [a] (mg/kg)	Notes	Benchmark [b] (mg/kg)	Plant Notes	
2,4-Dinitrophenol			20		
4-Nitrophenol	7				
N-Nitrosodiphenylamine	20				
Pentachlorophenol	6		3		
Phenol	30		70		
2,4,5-Trichlorophenol	9		4		
2,4,6-Trichlorophenol	10				
Chlorobenzene	40				
1,2-Dichloropropane	700				
Nitrobenzene	40				
Styrene			300		
Toluene			200		
1,2,3-Trichlorobenzene	20				
1,2,4-Trichlorobenzene	20				
PCBs			40		
Hexachlorocyclopentadiene			10		

Note: The screening benchmarks and the following notes are taken directly from Table 3-4 Ecological Benchmarks for Soil from TCEQ 2001. Table 3-4 update on February 24, 2004 (Ecological Work Group Meeting Notes).

a) Efroymson, R.A., M.E. Will, and G.W. Suter. 1997. Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotophic Process: 1997 Revision. Lockheed Martin Energy Systems, Inc. ES/ER/TM-126/R2.

b) Efroymson, R.A., M.E. Will, G.W. Suter, and A.C. Wooten. 1997. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects Terrestrial Plants: 1997 Revision. Lockheed Martin Energy Systems, Inc. ES/ER/TM-85/R3.

c) Texas-Specific Median Background Concentration (Figure 30 TAC § 350.51 (m)).

d) Potential ecological risks associated with aluminum in soils are identified based on the measured soil pH. Where aluminum is a COC, it should only be retained for those soils with a soil pH less than 5.5. Source: U.S. Environmental Protection Agency. Ecological Soil Screening Level for Aluminum. Interim Final. OSWER Directive 9285.7-60. November 2003.

e) U.S. USEPA Ecological Soil Screening Level for Antimony. Interim Final. OSWER Directive 9285.7-61. November 2003.

f) Screening values for soil invertebrates.

g) U.S. USEPA 2000. Ecological Soil Screening Level Guidance. Draft. Office of Emergency and Remedial Response. July 10, 2000.

h) U.S. USEPA 2003. Ecological Soil Screening Level for Barium. Interim Final. OSWER Directive 9285.7-63. November.

i) U.S. USEPA 2003. Ecological Soil Screening Level for Beryllium. Interim Final. OSWER Directive 9285.7-64. November.

j) U.S. USEPA 2003. Ecological Soil Screening Level for Cadmium. Interim Final. OSWER Directive 9285.7-65. November.

k) U.S. USEPA 2003. Ecological Soil Screening Level for Cobalt. Interim Final. OSWER Directive 9285.7-67. November.

l) Iron is not expected to be toxic to plants in well-aerated soils between pH 5 and 8. Iron's relative importance is not so much based on its direct chemical toxicity, but its effect as a mediator in the geochemistry of other potentially toxic metals and the potential hazard of depositing flocculent. Source: U.S. USEPA 2003. Ecological Soil Level for Iron. Interim Final. OSWER Directive 9285.7-69. November.

Table 4 Bioaccumulative Constituents

CAS RN	COPC	Applicable Media
7440-43-9	Cadmium	Sediment, soil
7440-47-3	Chromium	Soil
7440-50-8	Copper	Sediment, soil
7439-92-1	Lead	Soil
7439-97-6	Mercury	Surface water, sediment, soil
7440-02-0	Nickel	Sediment, soil
7782-49-2	Selenium	Surface water, sediment, soil
7440-28-0	Thallium	Surface water
7440-66-6	Zinc	Sediment, soil
309-00-2	Aldrin	Sediment, soil
57-74-9	Chlordane	Sediment, soil
319-84-6	alpha-BHC	Sediment, soil
319-85-7	beta-BHC	Sediment, soil
319-86-8	delta-BHC	Sediment, soil
58-89-9	gamma-BHC (Lindane)	Sediment, soil
72-54-8	4,4'-DDD	Surface water, sediment, soil
72-55-9	4,4'-DDE	Surface water, sediment, soil
50-29-3	4,4'-DDT	Surface water, sediment, soil
60-57-1	Dieldrin	Sediment, soil
72-20-8	Endrin	Sediment, soil
76-44-8	Heptachlor	Sediment, soil
1024-57-3	Heptachlor epoxide	Sediment, soil
8001-35-2	Toxaphene	Sediment, soil
1336-36-3	PCBs	Surface water, sediment, soil
118-74-1	Hexachlorobenzene	Surface water, sediment, soil
None	Dioxins/Furans	Surface water, sediment, soil

Source: TCEQ 2001 Table 3-1 Bioaccumulative COCs

CAS RN Chemical Abstracts Service Registry Number

Figures

Figure 1 – Site Location Map

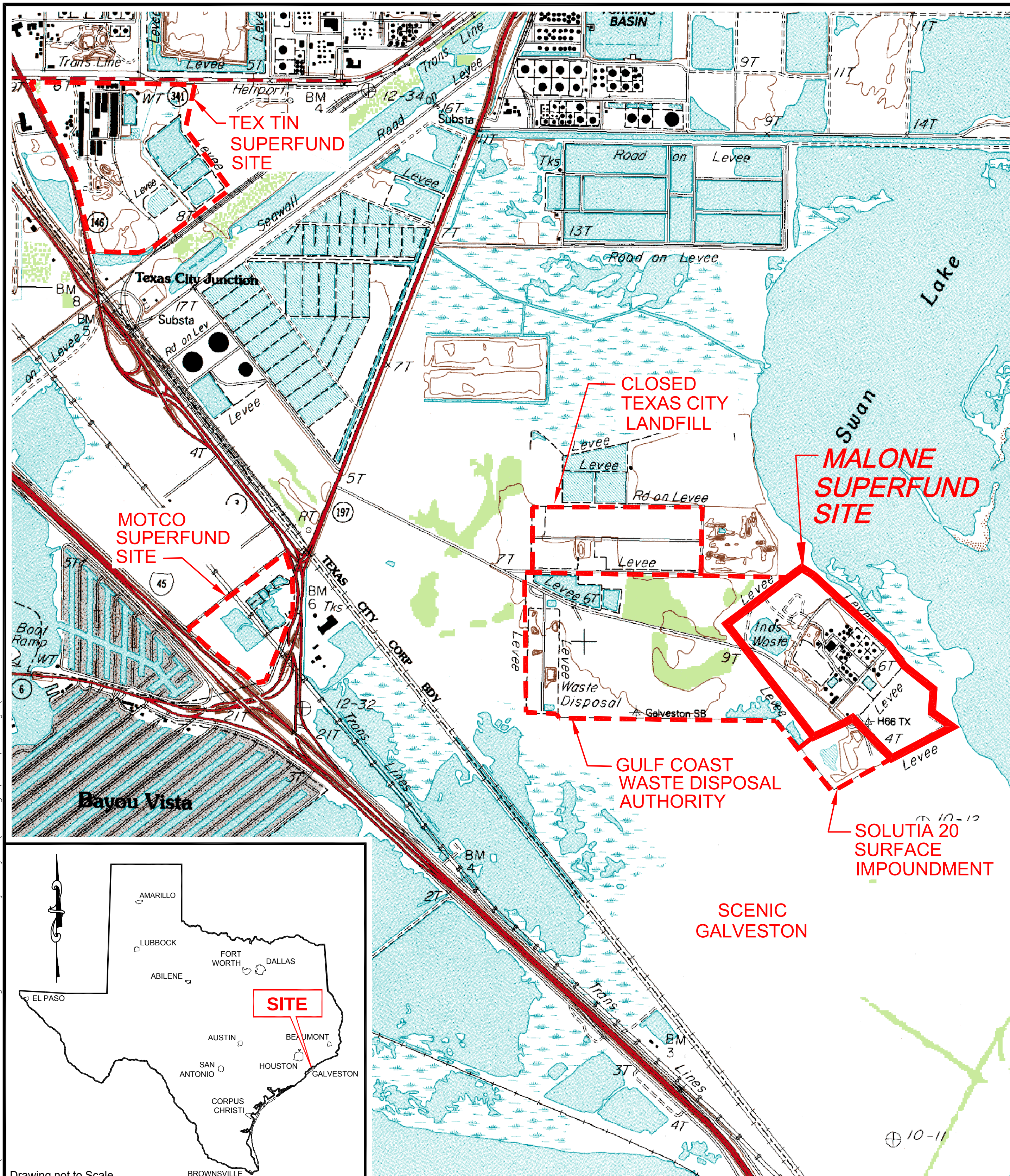
Figure 2- Site Map

Figure 3 - Soil/Sediment Sample Locations

Figure 4 – Conceptual Site Model

Figure 5 – 3-Dimensional Site Model

Figure 6 – Eight-Step Ecological Risk Assessment



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U.S.G.S. 7.5-minute series topographic map.
Virginia Point, Texas Quadrangle, 1994.

URS

9801 WESTHEIMER, SUITE 500
HOUSTON, TEXAS 77042
PH: (713) 914-6699
FAX: (713) 789-8404

Title: **SITE LOCATION MAP**

Project: **MALONE SERVICE CO. SUPERFUND SITE**

Client: **MALONE COOPERATING PARTIES**

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AERIAL PHOTO DATED NOV. 20, 2003

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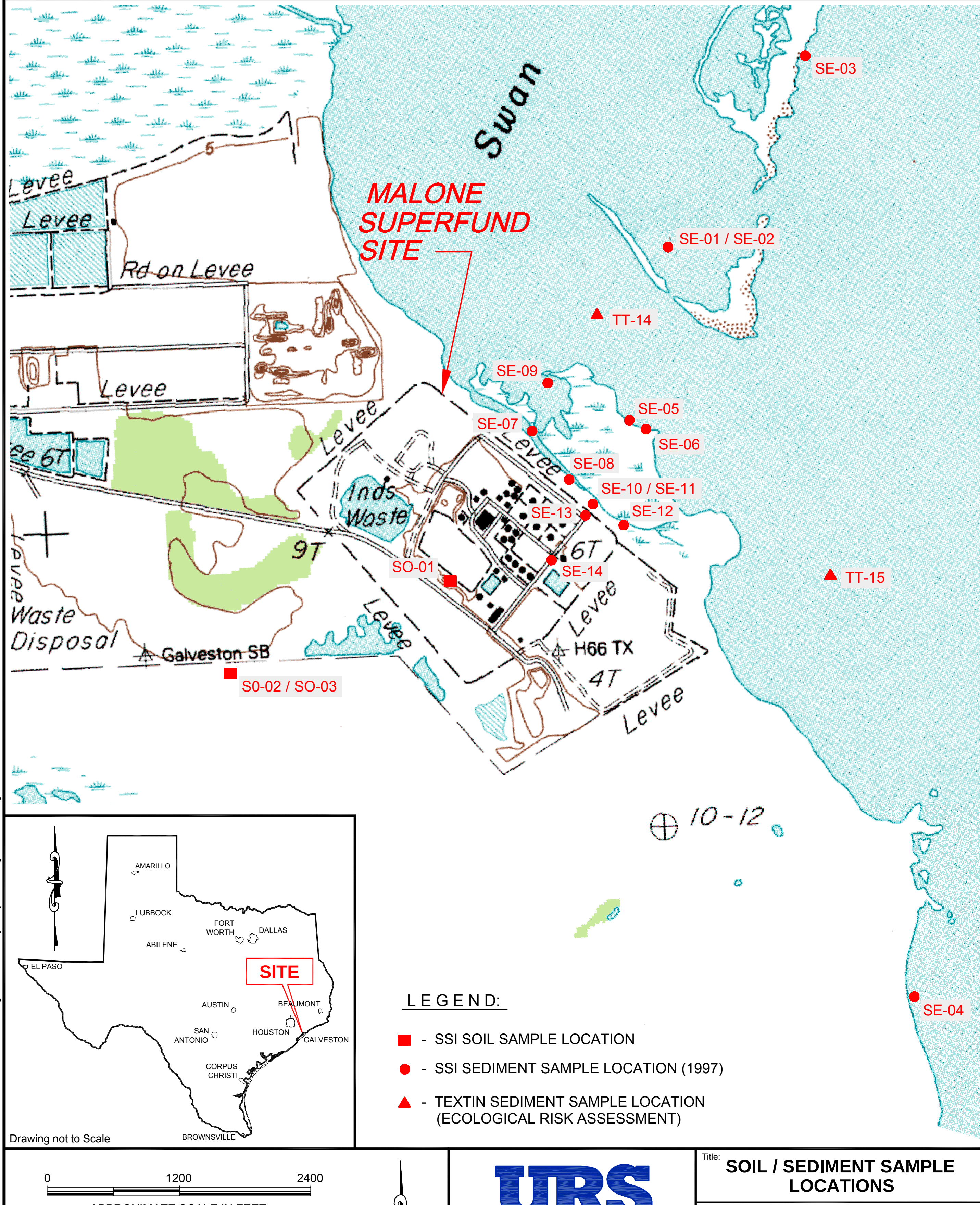

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U.S.G.S. 7.5-minute series topographic map.
Virginia Point, Texas Quadrangle, 1994.

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9801 WESTHEIMER, SUITE 500
HOUSTON, TEXAS 77042
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FAX: (713) 789-8404

Scale: As Shown	Drawn by: SJF	Date: 5-3-05	
	Chk'd by: BB	Date: 5-3-05	

Title:
SOIL / SEDIMENT SAMPLE LOCATIONS

Project:
MALONE SERVICE CO. SUPERFUND SITE

Client:
MALONE COOPERATING PARTIES

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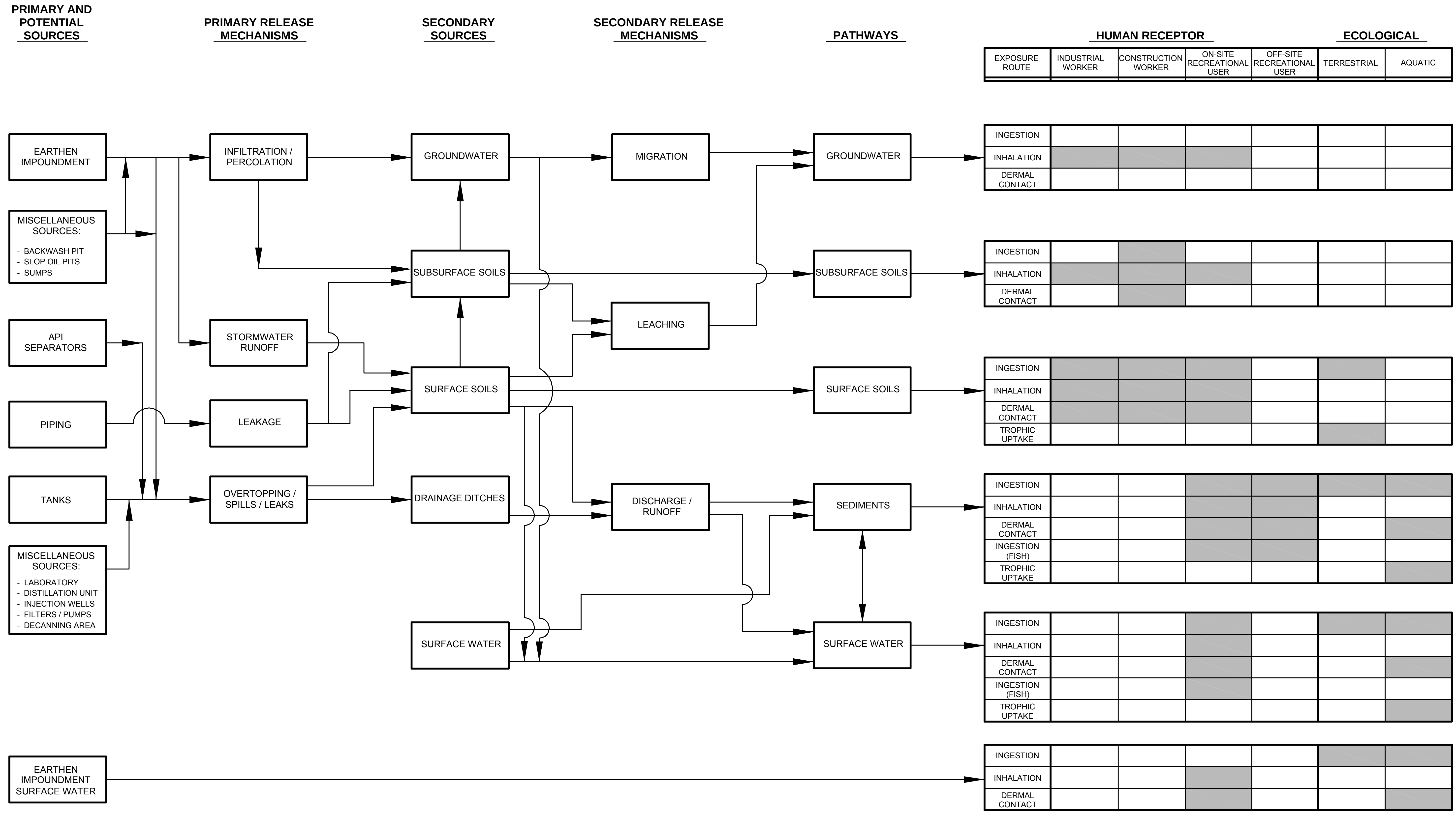

MALONE SERVICE CO.
SUPERFUND SITE

URS
9801 Westheimer
Suite 500
Houston, Texas 77042
PH: (713) 914-6699
FAX: (713) 914-8404

SCALE: AS SHOWN	DRAWN BY: SJF	DATE: 5-6-05
	CHKD. BY: BPB	DATE: 5-6-05

CONCEPTUAL
SITE MODEL

FILE NO.
CONCEP-MODEL

FIGURE NO.
4

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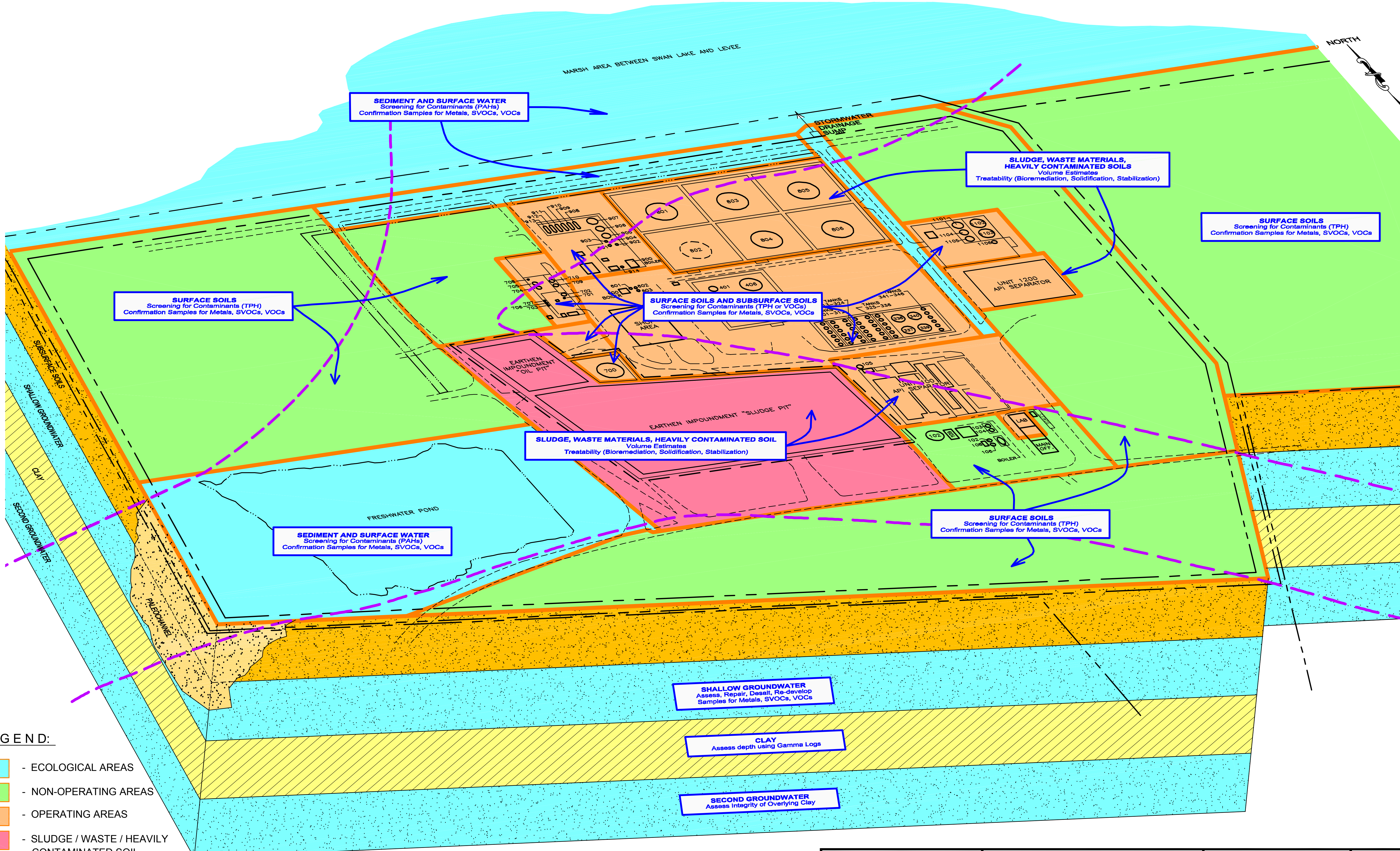

LEGEND:

- ECOLOGICAL AREAS
- NON-OPERATING AREAS
- OPERATING AREAS
- SLUDGE / WASTE / HEAVILY CONTAMINATED SOIL
- BOUNDARY PALEOCHANNEL

SOURCE:
BASE DRAWING OBTAINED FROM CLIENT AND WAS ORIGINATED BY ENVIRONMENTAL CONSULTING ASSOCIATES, AUSTIN, TEXAS, DATED SEPT. 1989.

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APPROXIMATE SCALE IN FEET

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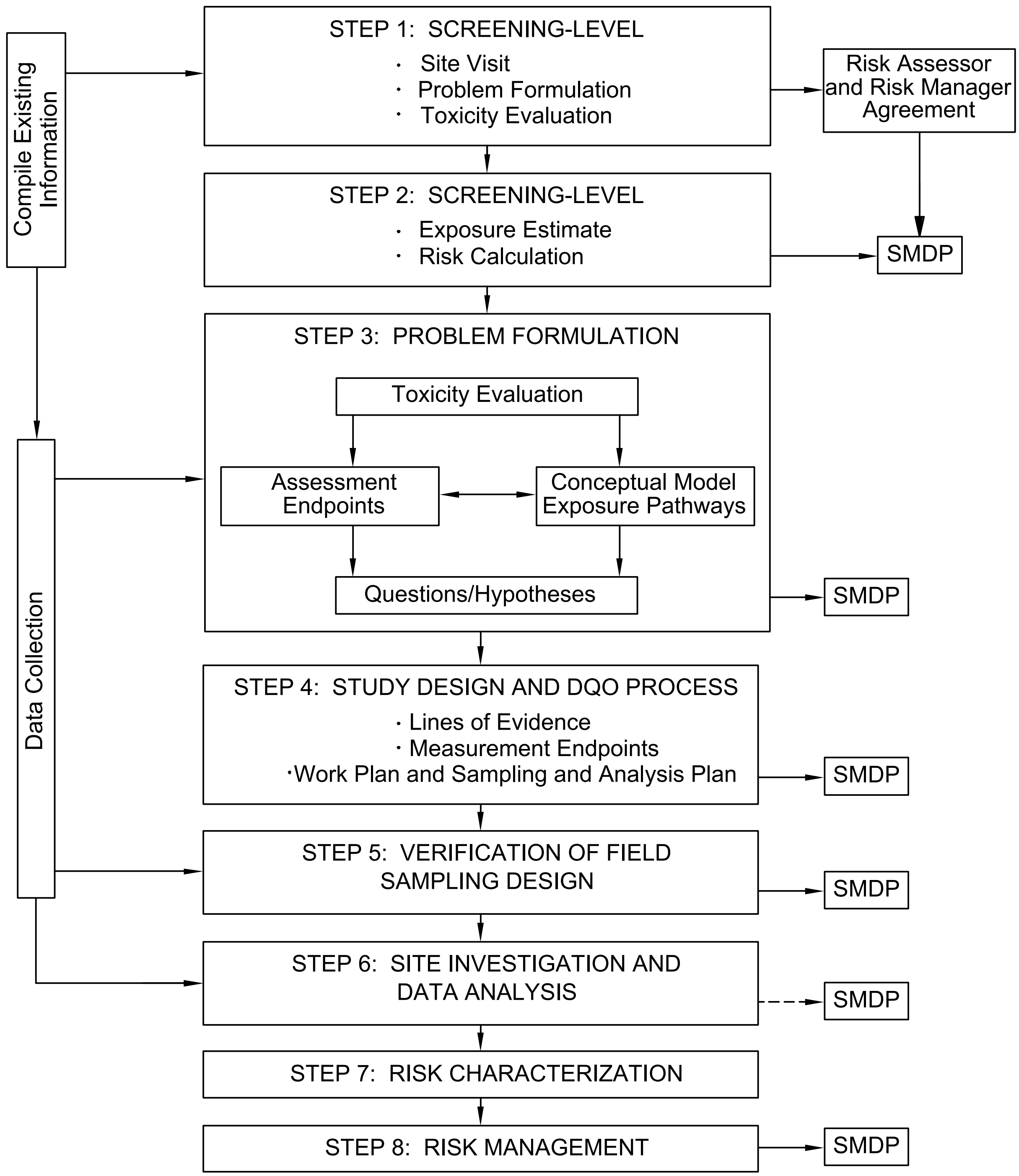
Eight Step Ecological Risk Assessment Process



SMDP - SCIENTIFIC MANAGEMENT DECISION POINT

URS
9801 WESTHEIMER, SUITE 500
HOUSTON, TEXAS 77042
PH: (713) 914-6699
FAX: (713) 789-8404

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Client: MALONE COOPERATING PARTIES					
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Appendix G –Treatability Study Work Plan